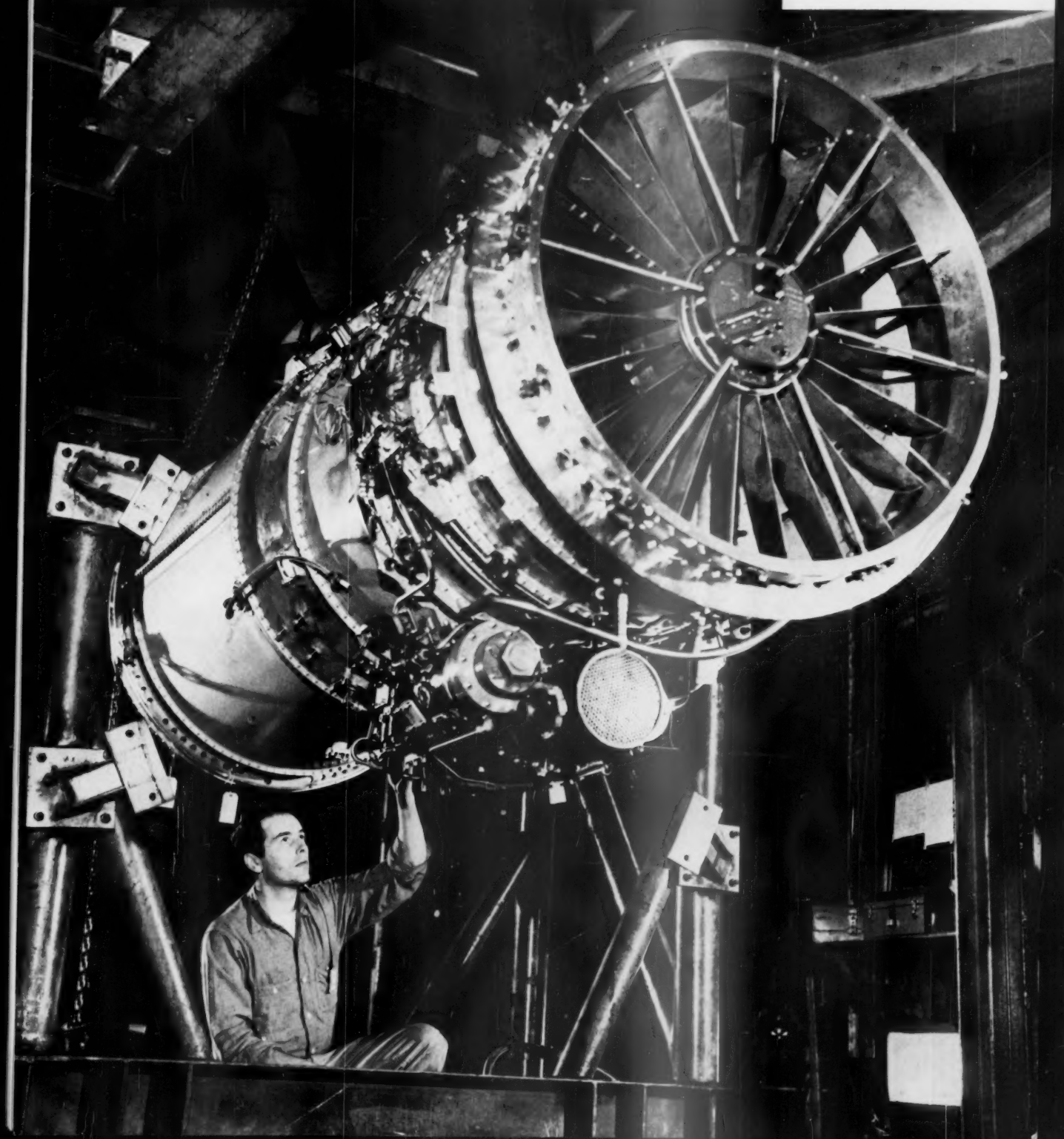
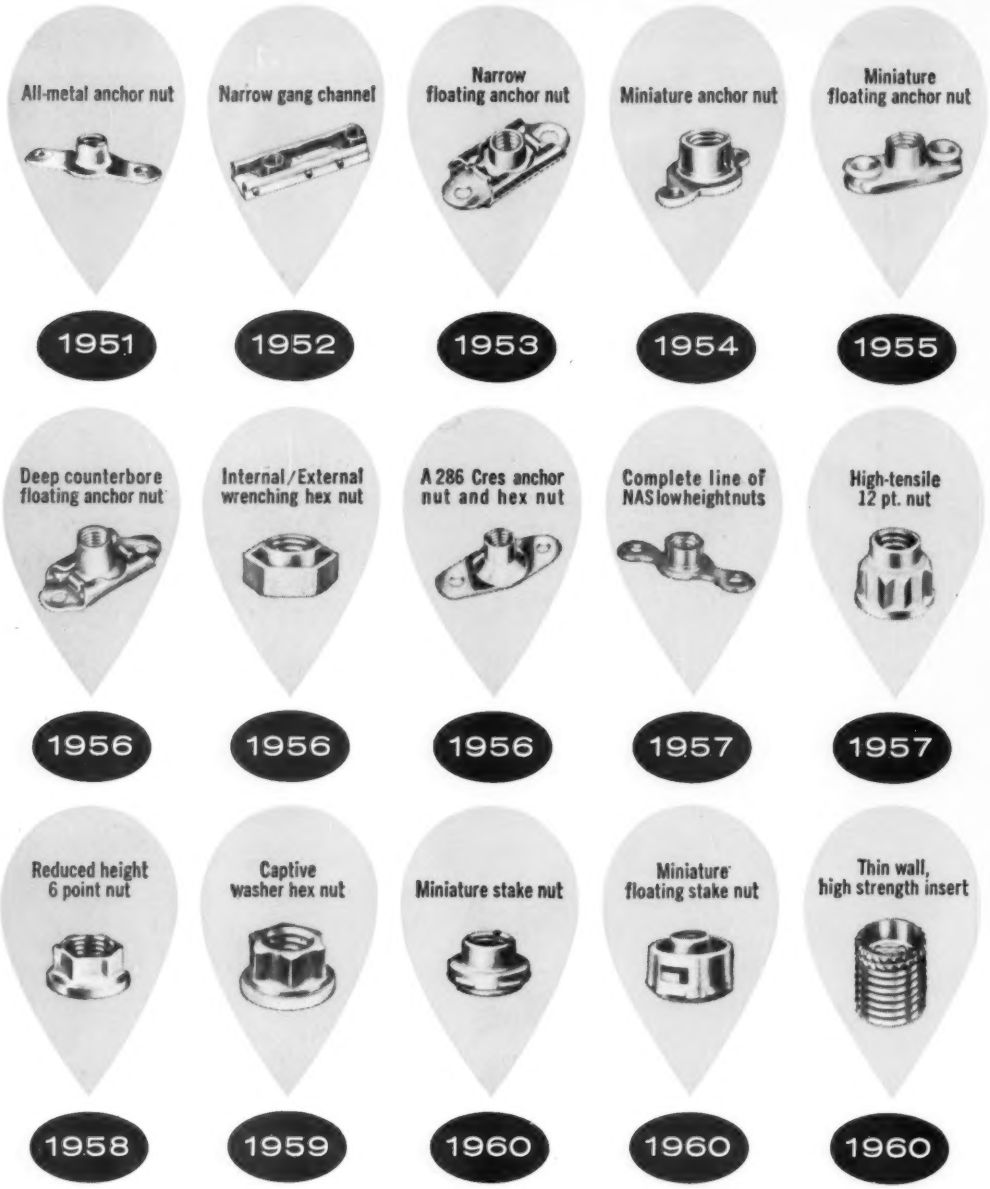
Aviation Week
and Space Technology

June 19, 1961

Designs Studied For Air-Scooping Orbital Vehicles

Pratt & Whitney JT8D-1 Turbofan Engine





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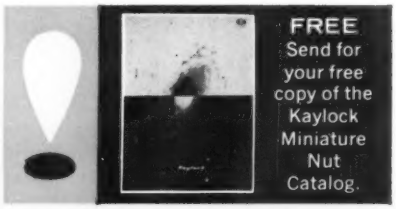
Kaynar Mfg. Co. Inc., the world's largest manufacturer of lightweight, all-metal self-locking nuts, leads the industry in solving aircraft, powerplant and missile fastening problems. Our elliptical locking feature is adaptable to an unlimited variety of configurations and materials, answering today's many sophisticated design requirements. Kaylock nuts are available in carbon steel – CRES steels for use to 1200°F – or exotic metals for temperature above 1200°F.



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KAYNAR MFG. CO., INC., KAYLOCK DIVISION
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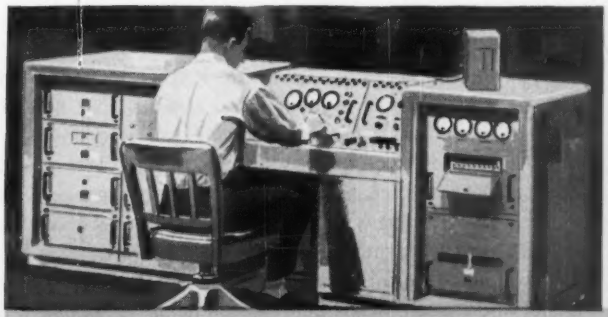

GAC missile guidance tester automatically and quantitatively checks complete Air Force Mace guidance system.

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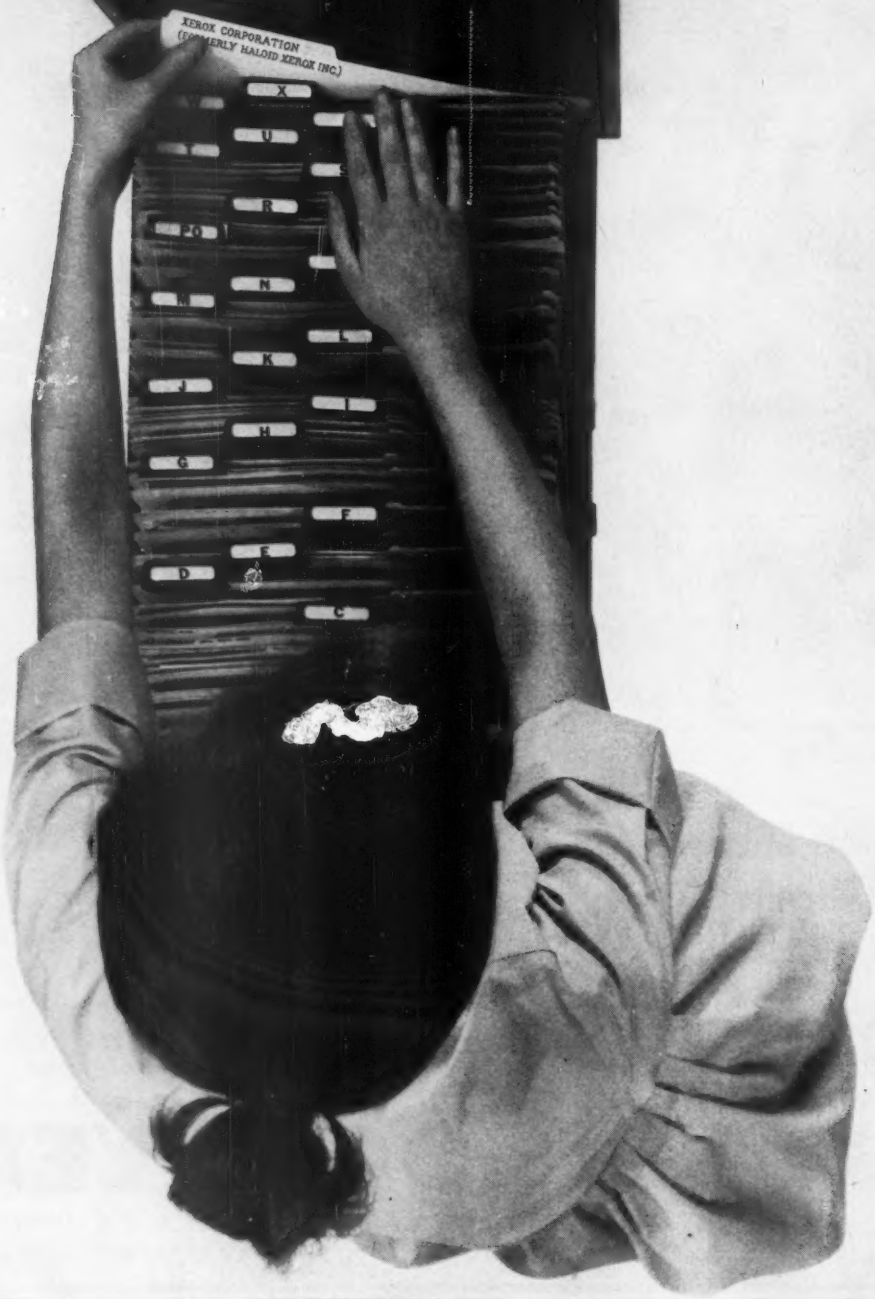
now X marks our spot



XEROX
CORPORATION

On June 1 the name of our company changed from Haloid Xerox Inc. to XEROX CORPORATION. Therefore, you will want to bring **your** reference files up-to-date. Then, when you're looking for information on office copiers, high-speed continuous printers and other reproduction equipment, you will find it—under "X." ■ Why this curious name "Xerox"? The word is of classic origin and stems from the Greek **xeros,** meaning "dry." And **dry** describes, perhaps as well as one word can, the revolutionary process on which our copiers and printers operate. ■ The initial "X" in all English words of ancient Greek origin is pronounced as a "Z." Hence, Xerox is pronounced **zerox** . . . but here we part company with all things ancient and Greek! ■ For the Xerox in our new corporate name stands for a modern, progressive, research-oriented company which, through exciting new products, is making its mark in the growing field of graphic communications. ■ In meeting the needs of modern business for better ways to record, condense, store, and recall the sheer mass of information, XEROX CORPORATION helps management to manage the future. For more information on our company, write XEROX CORPORATION, 20 Haloid Street, Rochester 3, New York.

AVIATION CALENDAR

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-28—European Symposium on Space Technology, British Interplanetary Society, London, England.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 27-29—International Symposium on Analytical Astrodynamics, Santa Barbara, Calif. (Contact: Capt. J. L. Gilbert, Air Force Office of Scientific Research, Washington 25, D. C.)

June 27-29—Airlines Operations Conference, Air Transport Assn., Wagon Wheel Lodge, Rockton, Ill.

June 28-29—Simulated Space and High Altitude Rocket Testing Symposium, Arnold Engineering Development Center, Tullahoma, Tenn. (Classified.)

June 28-30—Joint Automatic Control Conference, University of Colorado, Boulder.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 8-12—15th Annual All-Woman Transcontinental Air Race, San Diego, Calif.-Atlantic City, N. J.

July 13-16—Third Annual Industry Missile and Space Conference and Aerospace Exposition, Michigan Aeronautics and Space Assn., Cobo Hall, Detroit, Mich.

July 16-21—Fourth International Conference on Bio-Medical Electronics, Institute of Radio Engineers, Waldorf-Astoria, New York, N. Y.

(Continued on page 6)

AVIATION WEEK and Space Technology

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Vol. 74, No. 25

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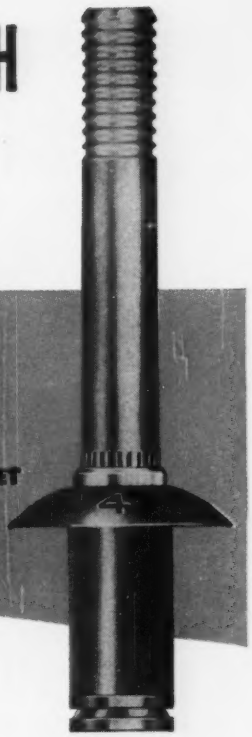

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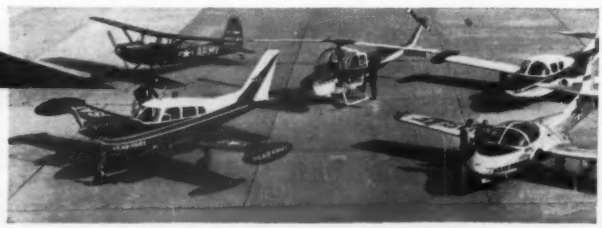

World's most experienced makers of utility military aircraft

AVIATION CALENDAR

(*Continued from page 5*)

July 17—Air Force Contract Aviation Services Symposium, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

July 20-21—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Grove Park Inn, Asheville, N. C.

July 24-26—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

July 26-28—Annual Convention, Southeastern Aviation Trades Assn., Deauville Hotel, Miami, Fla.

July 31-Aug. 11—Conference on Physics of the Solar System and Re-entry Dynamics. For information write: Conference Director, Room 310, Holden Hall, Virginia Polytechnic Institute, Blacksburg, Va.

Aug. 1-3—Fourth Western Regional Meeting, American Astronautical Society, Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 2-4—Summer Meeting on Aerospace Applications for Hydraulic Fluids Test Methods, American Society for Testing Materials, Santa Ynez Inn, Pacific Palisades, Calif.

Aug. 7-9—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

Aug. 15-17—Cryogenic Engineering Conference, University of Michigan, Ann Arbor.

Aug. 16-18—International Hypersonics Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 19-24—Institute of the Aerospace Sciences/Naval Aviation Meeting, San Diego, Calif. (Classified.)

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Aug. 24-26—Sixth Annual National Reunion, OX5 Club of America, Allis Hotel, Wichita, Kan.

Aug. 30-Sept. 1—Third Annual Semiconductor Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-14—Eighth Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace Sciences, London, England. Wilbur Wright Memorial Lecture, Sept. 12.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Sept. 20-24—National Convention and Aerospace Panorama, Air Force Assn., Philadelphia, Pa.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 9-15—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

Oct. 14-22—Federation Aeronautique Internationale 1961 General Conference, Hotel Quintandinha, Rio de Janiero, Brazil.

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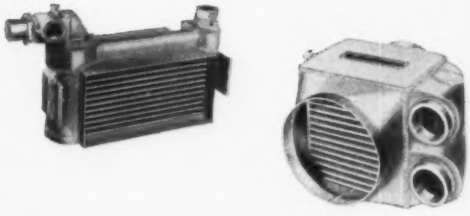

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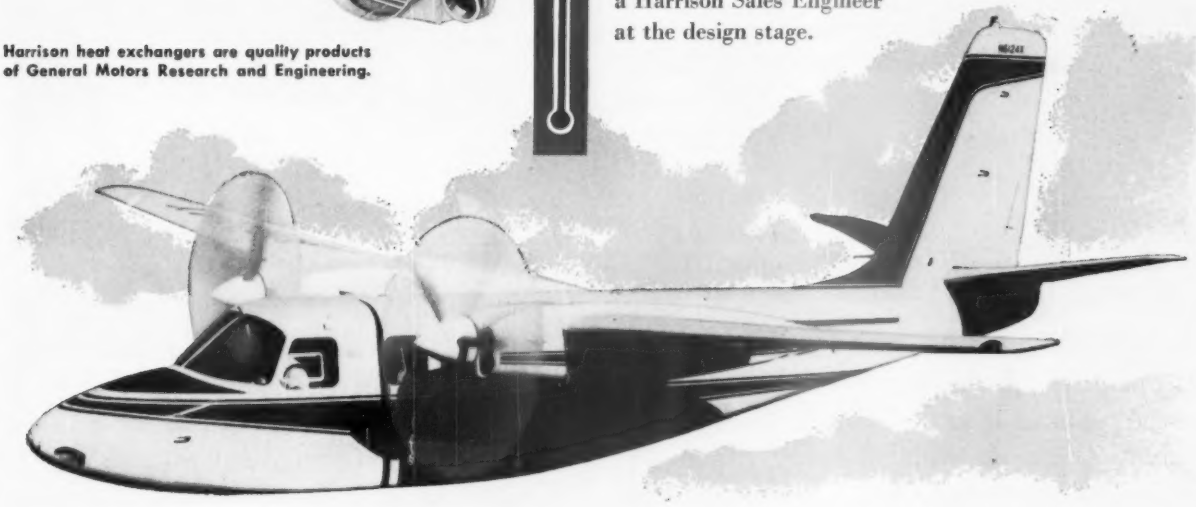

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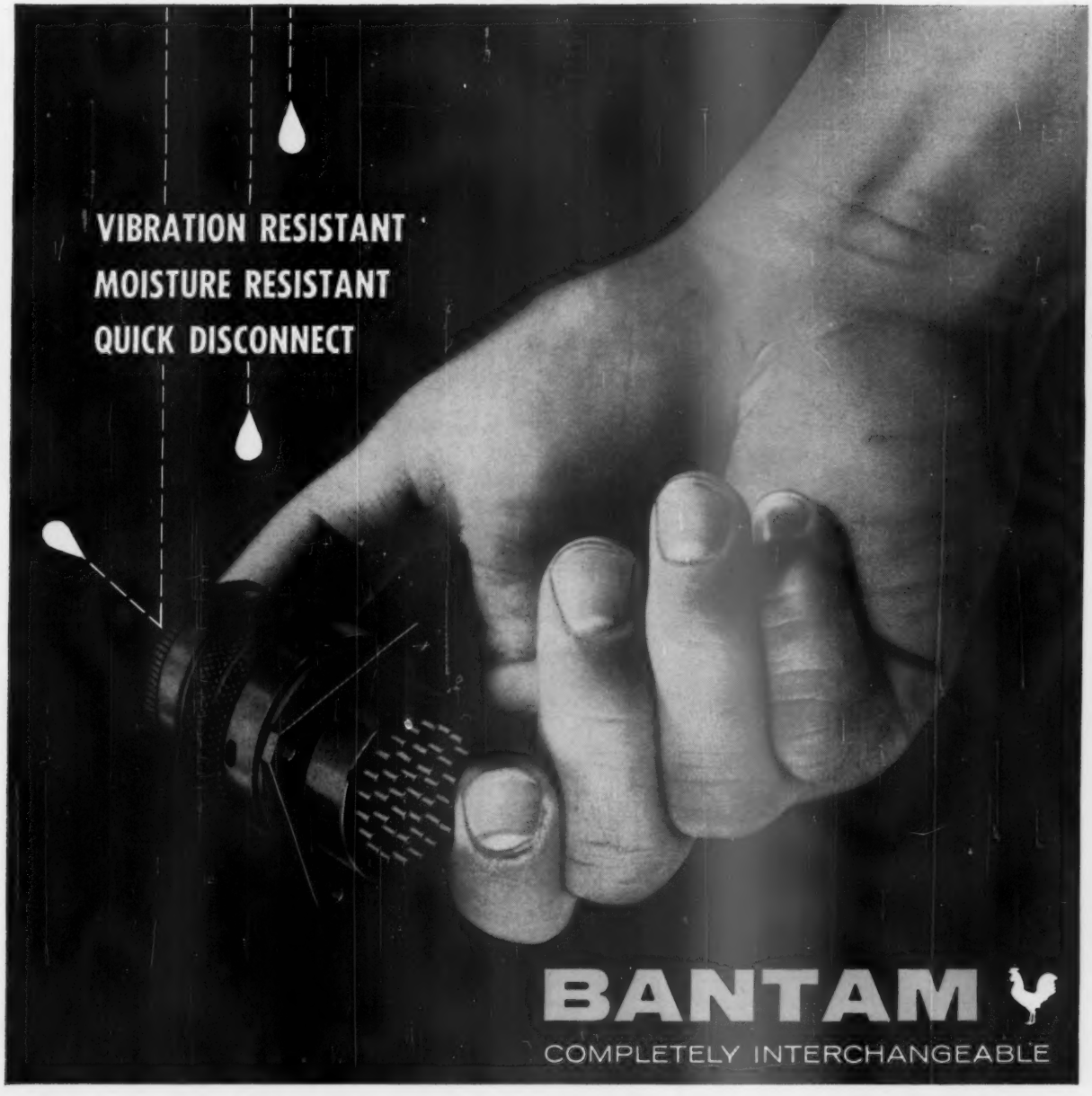

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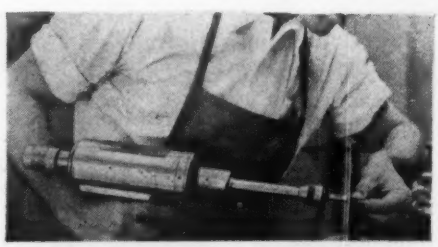

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a big boost for missile reliability

Vital but vulnerable missile components must "live" in severe aerospace environments. This requirement is being met with protection afforded by Lord-engineered mounting systems.

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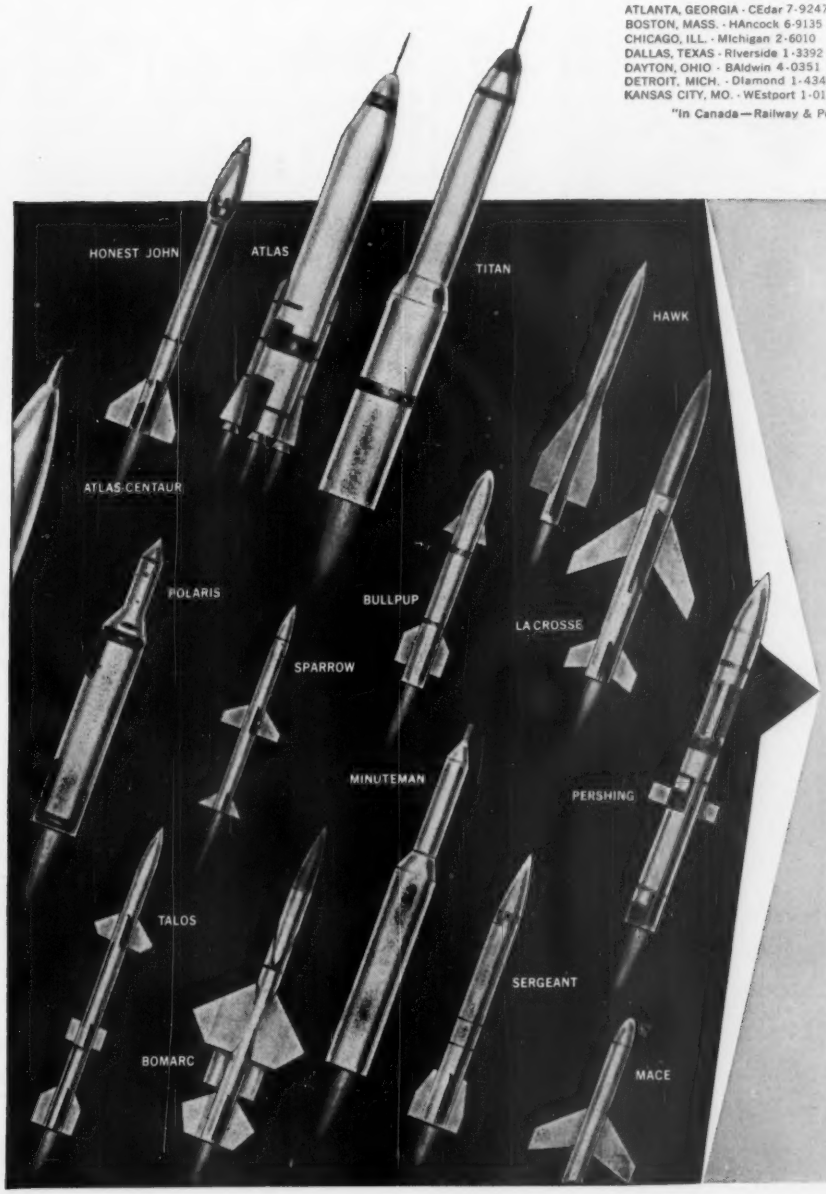

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. . . for fragile railroad lading

Elastomeric Mountings
. . . for missile carriers, trailers, ICBM transporters

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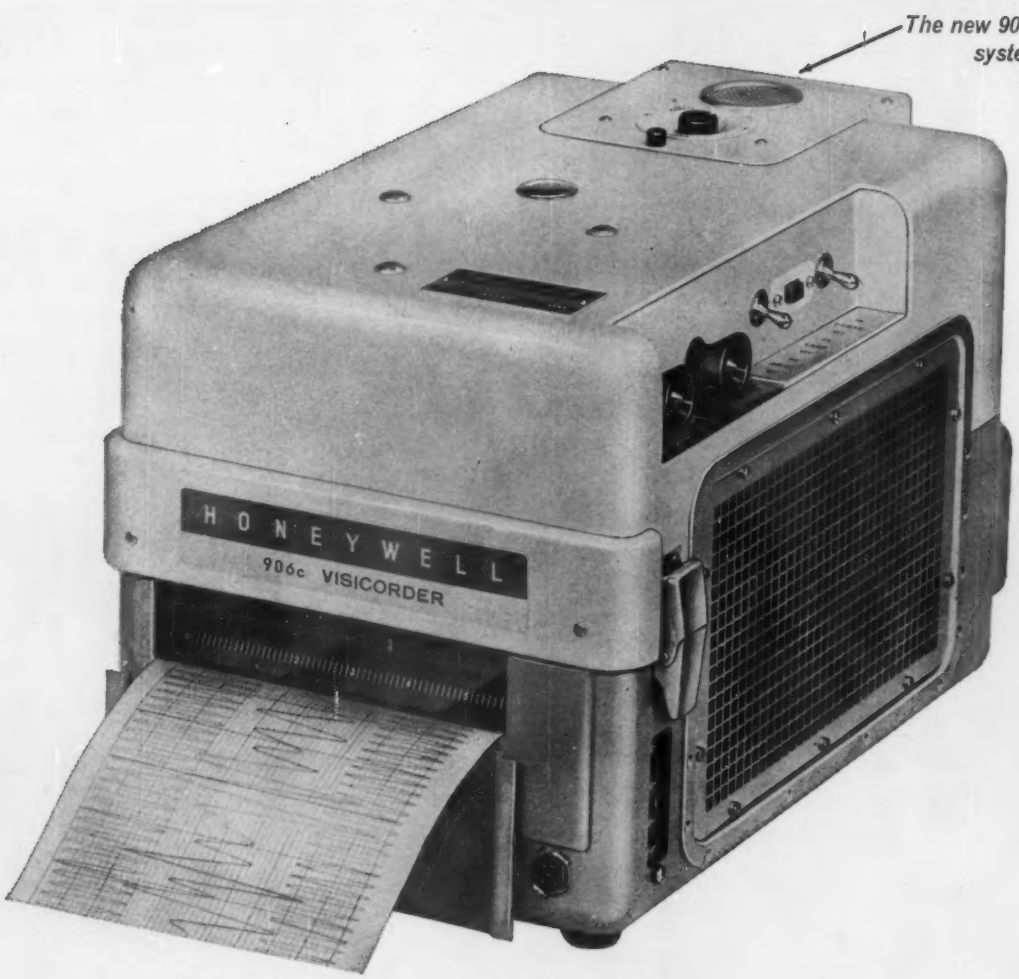

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(Owners of Visicorders 906, 906A, and 906B will be glad to know that only a *field-change* is necessary to economically and easily add this timing system to their instruments).

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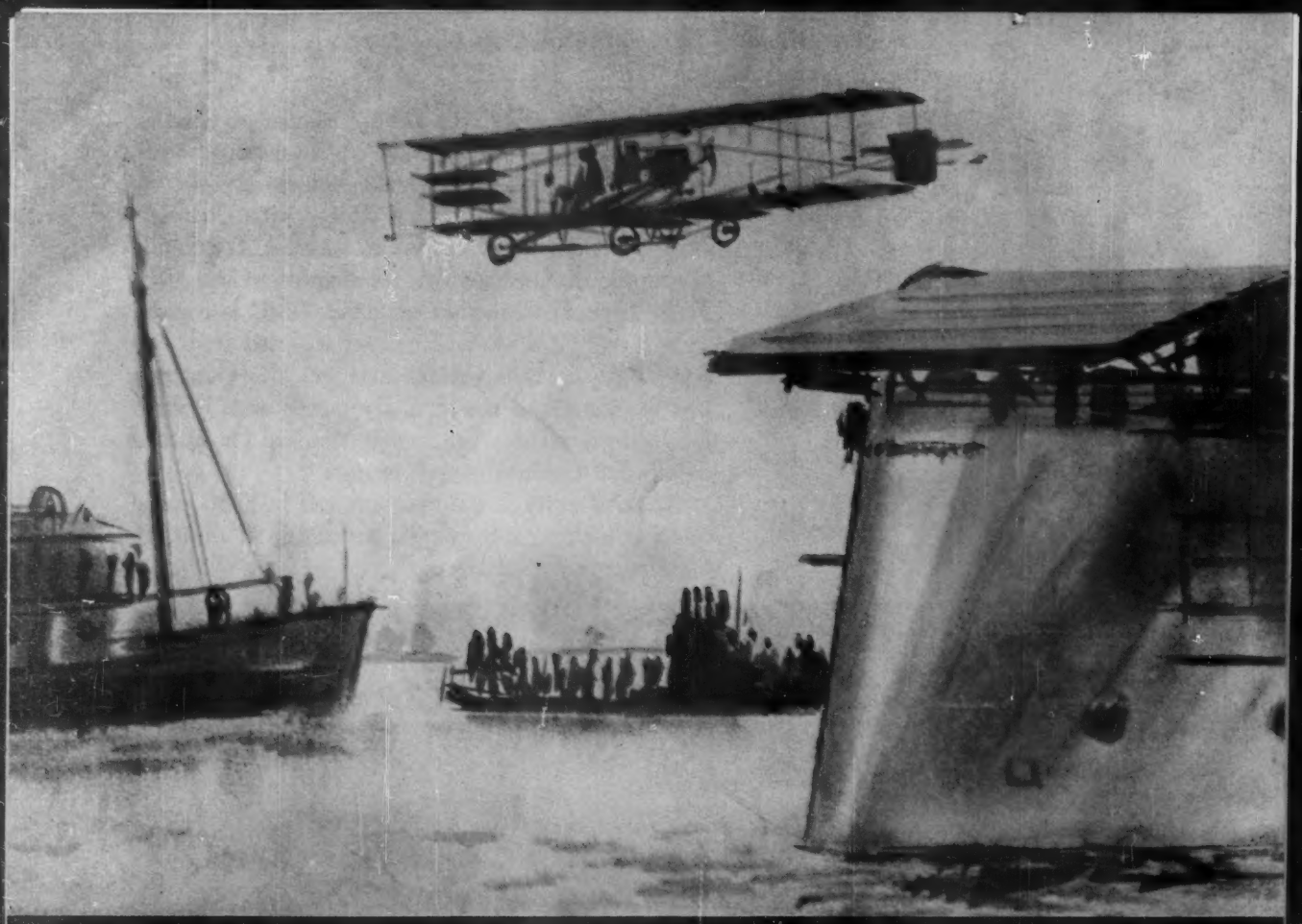

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NAVAL AVIATION 50th

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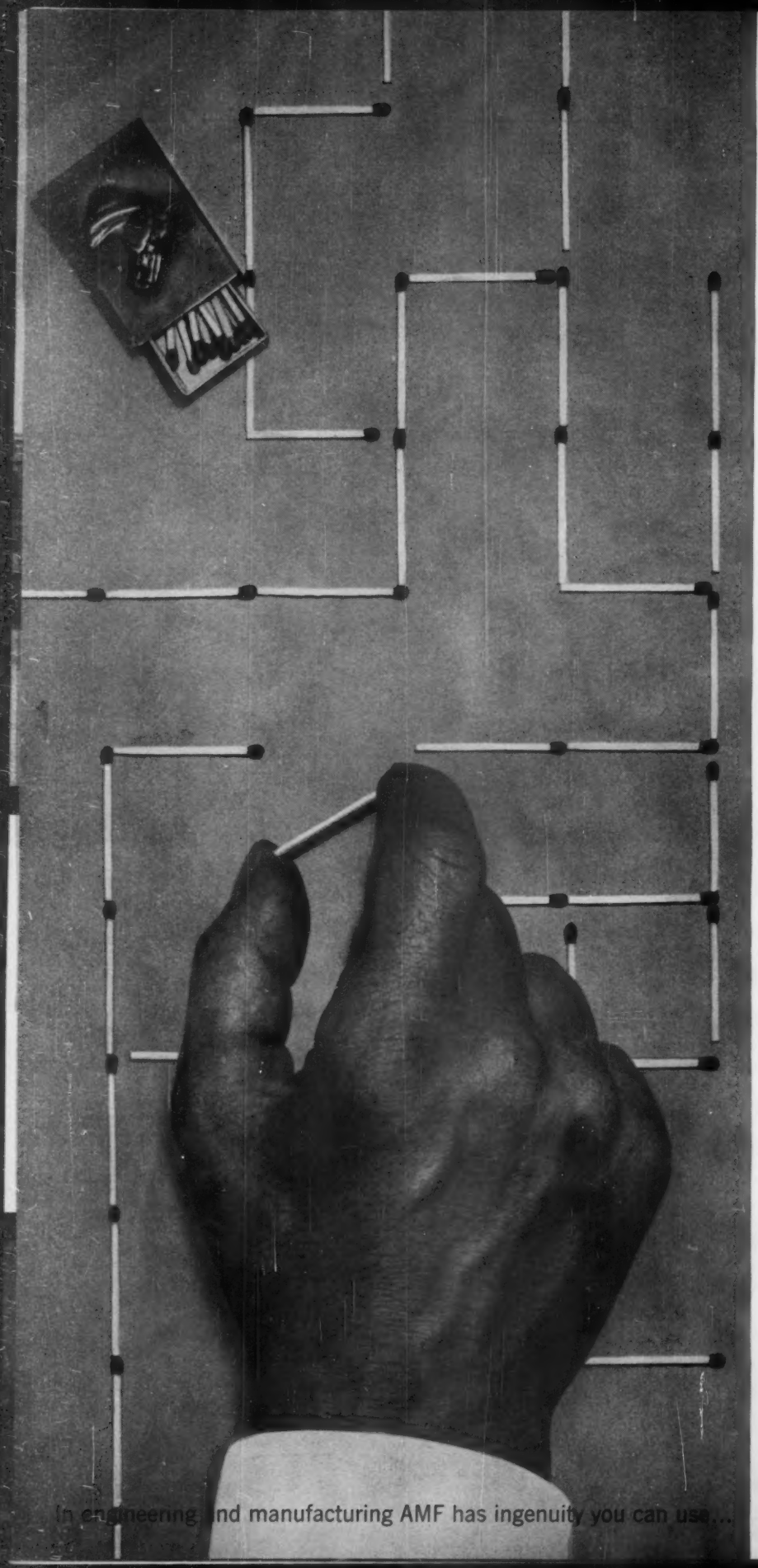

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June 19, 1961

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COVER: First development JT8D-1 turbofan is positioned in test cell at Pratt & Whitney Aircraft Division of United Aircraft plant in East Hartford, Conn. The JT8D will power the Boeing 727 short-medium range three-engine transport. Engine weighs 2,994 lb. and develops 14,000 lb. thrust. The turbofan has accumulated more than 60 hr. in the test stand since photo was taken. Flight tests will be conducted this fall.

PICTURE CREDITS

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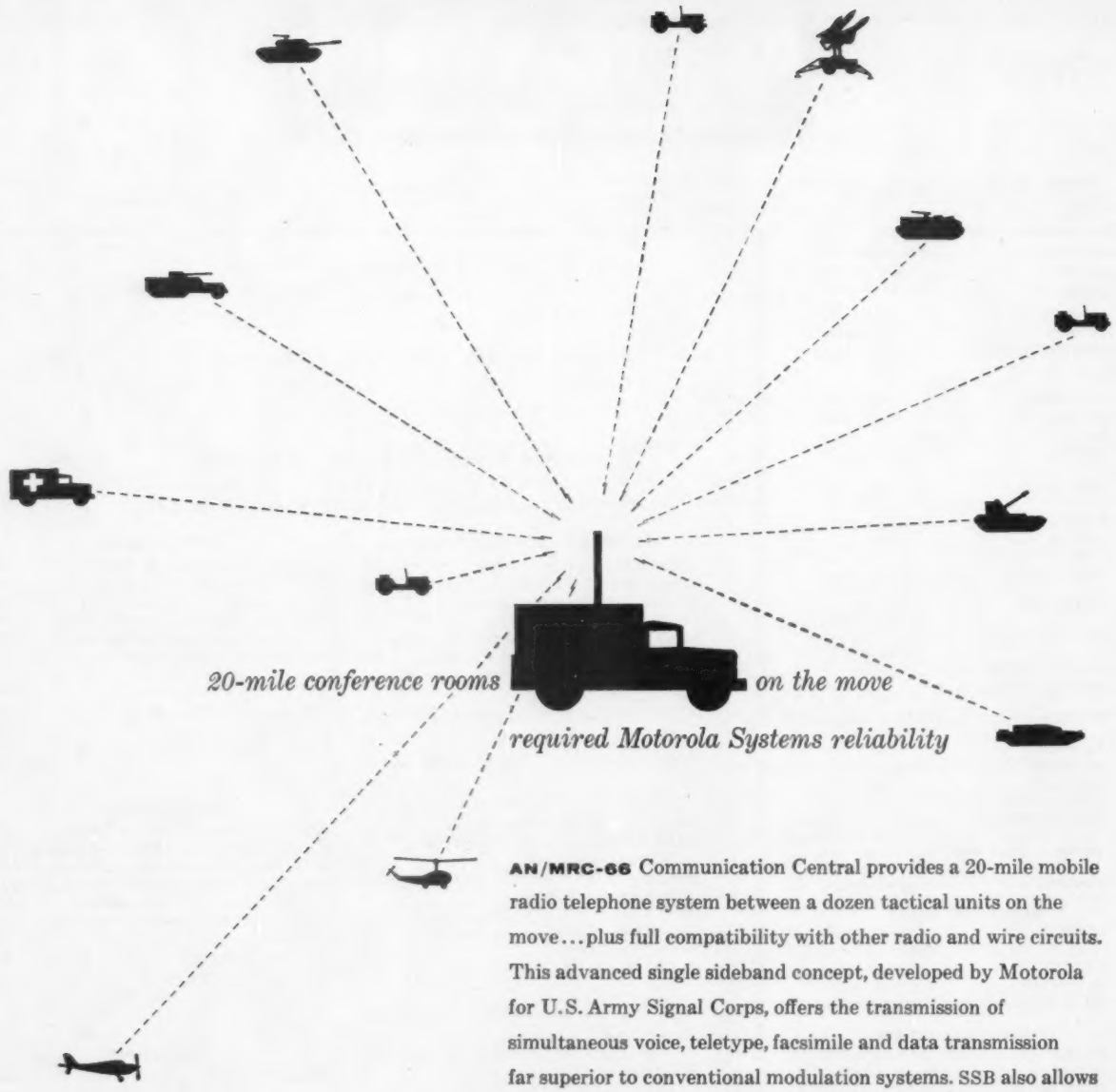

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EDITORIAL

Our Best Foot Forward

As the chill of the cold war cuts deeper, it becomes increasingly obvious that the United States must devote considerable thought and energy to projecting a realistic image of its strength, vitality and determination to maintain its basic concepts for friends, foes and neutrals to see and believe. As long as we had a national leadership with the philosophy of an aging heavyweight champion of the world, hoping to retire undefeated and ignoring the challenge of any new contenders no matter how vigorous and dangerous, this type of image was difficult to project abroad.

In fact, this philosophy contributed substantially to the misconception, still current in many parts of Europe, Africa and Asia, of the United States as a currently prosperous nation too flaccid and complacent to defend and maintain its position in the world—equally indifferent to the welfare of its friends and the defeat of its enemies.

Fortunately, President Kennedy, from his inaugural address onward, has sought to change this image and reaffirm the vitality of a still young nation determined to meet the challenge of the times and confident of its ultimate success despite the harassment of temporary failures. In the effort to project this type of image, the aerospace field must play a key role. For it is in the galloping new technologies of the aerospace frontiers that the world at large has found a readily applicable yardstick by which to measure the relative vitality of the competing systems of the United States and the USSR.

Last week, we emphasized the tremendous impact that our full technical participation, both with men and machines, in the Paris International Air Show produced on the European community. There also have been other significant activities in this area that are adding to this cumulative effect and should be strongly encouraged and continued.

One of these is the well organized assault on world records for aircraft and helicopters that has been sparked by Jacqueline Cochran, president of the National Aeronautic Association, directed by the new NAA executive director Ralph Whitener and supported fully by the military services through Vice Adm. Robert B. Pirie, deputy chief of naval operations for air; Maj. Gen. Richard M. Montgomery, USAF assistant vice chief of staff, and Brig. Gen. Clifton von Kann, director of Army aviation. For a number of years, Defense Department policy barred the use of our best military aircraft for world record attempts and left this field largely to British, French and Russian competition.

By the middle of last year, the Soviets had captured 106 official world helicopter and aircraft records in contrast to 98 held by the United States. Thanks to the new leadership of NAA, backed by full cooperation of the aerospace industry and the military services, the scoreboard now stands at 115 records held by the United States and 103 held by the Soviets. The United States has recaptured 27 world records since January and has 15 more attempts scheduled to swell this total in the next few months.

The fact that many of these records were recaptured from the Soviets has not been lost on the rest of the world. The importance of these record performances, both the spectacular absolute speed, altitude and closed course marks and the class records with payloads, is best attested by the frantic Soviet efforts to surpass the U. S. marks and return these records to the USSR. Contrary to the erroneous opinions of some amateur military security "experts," these record performances do not disclose the significant military performance parameters of these aircraft.

But even more significant than the determined effort to prove by performance the technical superiority of our aerospace equipment is the open manner in which these record runs are conducted and documented. For it is in this contrast, between U. S. willingness to authenticate and document its performances fully with international observers when required and the Soviets' medieval secrecy that even refuses to show a picture of its alleged record-breaking aircraft, that the basic differences between the two ways of life are becoming clearly apparent all around the world.

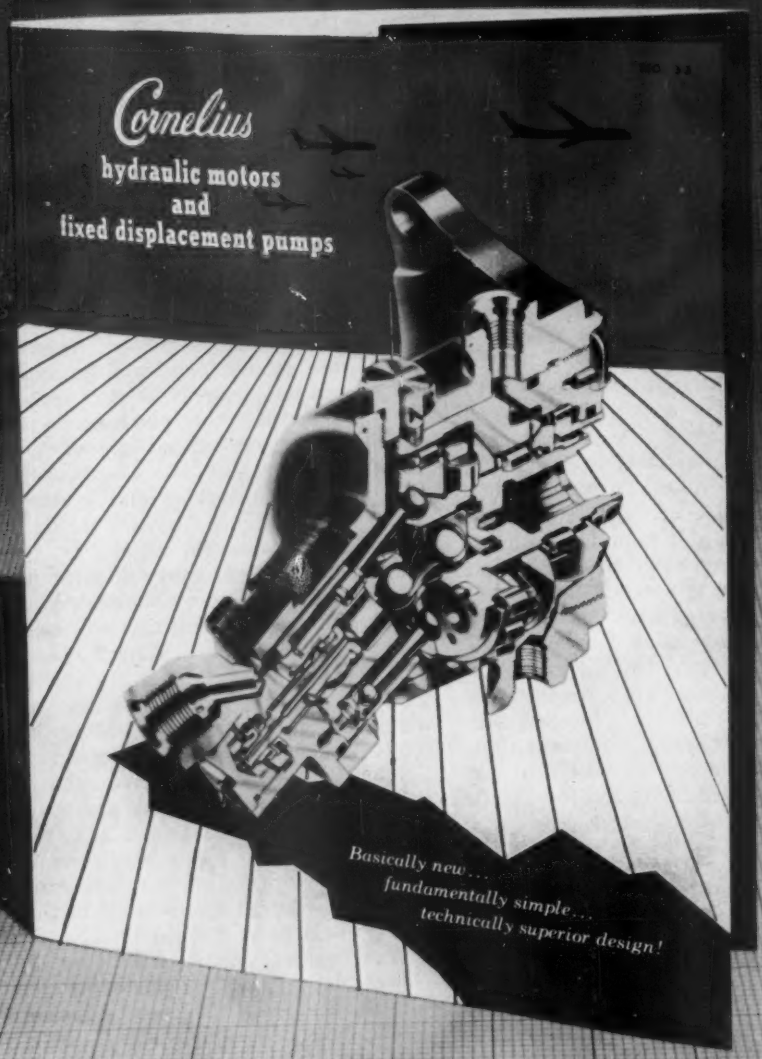
When Cdr. Alan Shepard made his first Mercury space flight from Cape Canaveral, Jacques Allez, president of the Federation Aeronautique Internationale, was in the blockhouse at Cape Canaveral observing the instrumentation to authenticate any U. S. claims for space flight records, which have since been submitted to the FAI for homologation. When the FAI met in Paris a few weeks ago, the Soviet delegates were acutely embarrassed by their inability to offer similar opportunities to Mr. Allez. Their guarded statements that they thought he might be able to see "something" of the next Soviet space flights hardly impressed either the FAI president or the other international delegates.

Another contrast was provided by the Paris Air Show, where the top U. S. record-holding aircraft and helicopters were on static and flying display while the Soviets did not even display a picture of any of their aircraft, for which they have submitted record claims under phony designations such as the "E-66 monoplane," etc.

The proposed American Rocket Society "Space Flight Report to the Nation" scheduled for New York in October, with its strong attraction for international scientists, is another step in the right direction. The invitation to Soviet space scientists to participate in this event should provide another striking contrast between the free interchange of scientific information on this side of the Iron Curtain and the type of secrecy behind it that can only be interpreted by the rest of the world as a symptom of inferiority and a lack of ability to compete truly and openly with the free world.

It is ironic that at this late date it should be necessary to harangue the leadership of a nation that grew to its present stature through tough competition with all comers in all fields on the importance of continuing to compete internationally in the vital technologies of our times. Even the relatively small efforts made since January in this direction have already paid rich dividends. If they are encouraged and continued, the Soviets will find themselves hard pressed to maintain their current international image of scientific or military parity or superiority, and the true measure of these two competing systems should be readily apparent for the whole world to see.

—Robert Hotz



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WHO'S WHERE

In the Front Office

J. T. Lidbury, board chairman of Hawker Aircraft, Ltd., succeeding **Sir Roy Dobson,** vice chairman of the Hawker Siddeley Group, who will remain on the board. **Sir Sydney Camm,** (see p. 129) chief engineer, succeeds Mr. Lidbury as managing director. Other Hawker board appointments: **R. L. Lickley,** deputy managing director; **E. G. Rubython,** general manager; **W. J. Heasman,** secretary. Mr. Lidbury also succeeds Sir Roy as chairman of Folland Aircraft, Ltd., and Mr. Lickley succeeds Mr. Lidbury as managing director.

Harold D. Kube, a director of Frederick Research Corp., Wheaton, Md. Mr. Kube is treasurer of Jansky & Bailey, a division of Atlantic Research Corp.

General Dynamics Corp., New York, N. Y., has appointed the following as vice presidents in four new divisions (see p. 99) of the corporation: General Dynamics/Astronautics—**Mortimer Rosenbaum** (division executive); **Wallace W. Withee** (research and engineering); **Elwood D. Bryant** (operations); General Dynamics/Convair—**J. H. Famme** (operations); **E. R. Peterson** (engineering); General Dynamics/Pomona—**Charles D. Perrine, Jr.,** (research and engineering); **G. E. Sylvester** (operations); General Dynamics/Ft. Worth—**Robert H. Widmer** (research and engineering); **B. G. Reed** (operations).

Starr W. Cahill, vice president-manufacturing, Hycon Manufacturing Co., Monrovia, Calif.

Roger Bowen, executive vice president, Cannon Electric Co., Los Angeles, Calif.

Donald G. Fink, vice president-research, Philco Corp., Philadelphia, Pa.

Ralph O. Romaine, vice president, Edo Corp., College Point, N. Y. Mr. Romaine will succeed **Archibald M. Brown,** Edo's vice president-sales, upon his resignation on Aug. 1. Mr. Brown continues as a director of Edo and as president of Edo (Canada) Ltd.

M. H. Whitlock, vice president-line maintenance, United Air Lines, Inc. Also: **O. T. Larson,** vice president-transportation services for Western operations (with headquarters in Denver); **Fred A. Brown,** assistant vice president and general manager-transportation services for Eastern operations (with headquarters in Washington, D.C.). **R. W. Hardesty** has been named the assistant general manager, Washington, D.C.

W. T. Noll, a divisional vice president, Minneapolis-Honeywell Regulator Co. Mr. Noll is general manager of the company's Aeronautical Division facilities in Minneapolis and Los Angeles.

Robert F. Hurt, vice president-operations, Grand Central Rocket Co., Redlands, Calif.

Arthur L. Chapman, senior vice president, Pacific Mercury Electronics, Sepulveda, Calif.

Arthur G. Baitz, an assistant vice president, Robertshaw-Fulton Controls Co., Richmond, Va., and general manager of the company's Eastern Research Center, King of Prussia, Pa.

Marion J. Stock, comptroller, Solar Aircraft Co., San Diego, Calif.

(Continued on p. 129)

INDUSTRY OBSERVER

► Raytheon team has been selected to handle research and development for advanced Research Projects Agency's new terminal defense against ballistic missiles, called ARPA Terminal or ARPAT (AW May 22, p. 19). Raytheon team includes Hughes Aircraft, which will be responsible for the interceptor vehicle, Boeing and IBM's Federal Systems Division. Initial contract will be for about $8 million.

► **Air Force is expected to ask for bids on its large solid propellant booster in about six weeks. Engines will have to produce 3 million lb. of thrust for 90-100 sec., and as many as seven may be clustered in a booster stage. Requests are expected to specify segmented engines but may leave the question of conical vs. cylindrical segments up to the bidders.**

► Orbit of Venus and return to earth is one spacecraft mission for the proposed six-stage, 395-ft. high Nova space launch vehicle. Three upper stages for this configuration are a single Rocketdyne J-2, six Pratt & Whitney LR-115s and a fluorine-hydrazine engine.

► **Army and Navy both plan to invest in further development of the Lockheed rigid rotor helicopter design which was runner-up in the light observation helicopter competition. Lockheed has been flying a prototype which obtains directional movement by changing the angle at the gimbal where the rotor shaft is mounted on the fuselage. Lift is controlled by varying engine speed. The design reportedly offers inherent stability and saving of more than 50% both in original cost and maintenance cost.**

► French and West German governments have ordered six pre-production models of the Transall cargo aircraft, which is being developed jointly by French and German companies. First flight of the military transport, powered by two Rolls-Royce Tyne turboprops, is scheduled for July, 1962. Five prototypes were ordered initially, including two for static testing. French and German defense ministries together expect to order about 200 aircraft.

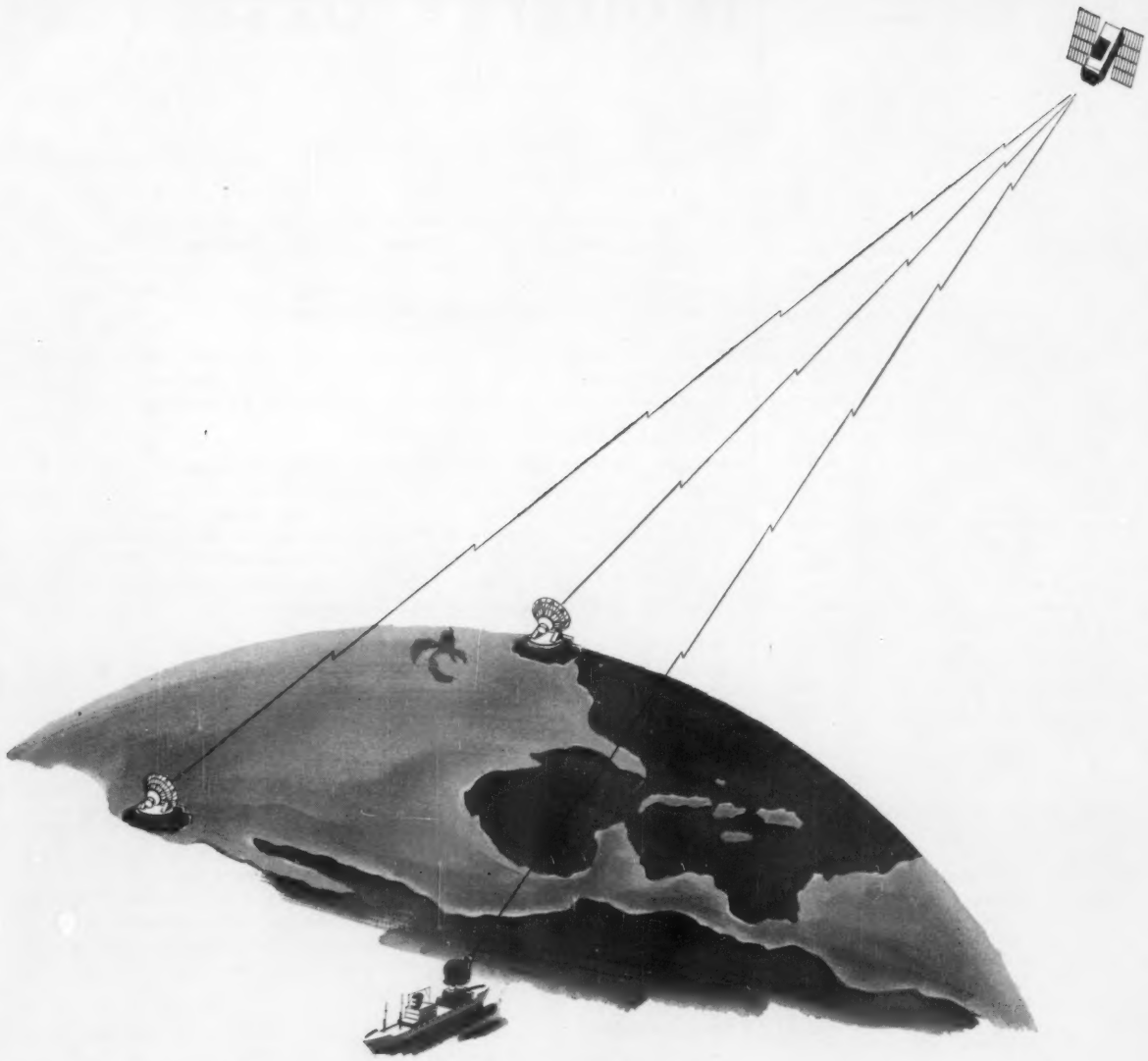
► **First model of Gyrodyne's DSN-3 DASH drone anti-submarine helicopter, which will be the operational version, flew Apr. 6, and delivery to the Navy is expected next month. Earlier models were powered by a gasoline-fueled Porsche automotive engine, but DSN-3 is powered by a Boeing T50-BO-4 burning JP-5 because the Navy decided to stop all installation of more hazardous aviation gas facilities on destroyers. Nine models of the DSN-1, which has undergone sea trials (AW June 12, p. 113), were built, of which four crashed. Three DSN-2s were built.**

► Electrostatic tape system will be carried on Nimbus II and subsequent weather satellites under the present plan. The tape system was eliminated from Nimbus I because development is not expected to be completed in time for a mid-1962 launch. RCA has built an operating breadboard model of the system.

► **Success of Northrop's boundary layer control research will be a key to the decision on developing a subsonic, long-endurance Dromedary-type bomber instead of the Mach 3 B-70 (see p. 105). Northrop work is aimed at smoothing the boundary layer over the wing, reducing drag and increasing endurance (AW May 29, p. 61).**

► Purchase of four Scout vehicles and six satellites is covered by Navy's request for $4.8 million in Fiscal 1962 procurement funds for its Transit experimental navigation satellite. Program has cost $54.55 million to the end of Fiscal 1961. Prototype operational design will weigh 90 lb. instead of the 250 lb. in the current experimental series and will be launched by Scout in early 1962. In addition to being lighter, the satellites will have significant increases in electrical power and satellite memory capacity.

► **Portable microlock telemetry stations may be located in Ethiopia, India, Singapore, Hawaii and Guam to receive instantaneous data from the Explorer XI gamma ray telescope satellite launched Apr. 27. The power system is supplied by solar cells, and the satellite has an estimated useful life of a year.**



ADVENT OF A NEW ERA IN COMMUNICATIONS will come about through the use of wide-band microwave radio repeaters in stationary satellites. Under the over-all direction of the U.S. Army ADVENT Management Agency, Bendix is developing satellite repeaters and ground terminal equipment for the Army Signal Corps, and a shipboard terminal for the Navy Bureau Of Ships. This important participation in Project ADVENT exemplifies the new technical challenges and careers offered by our expanding Space Laboratory.

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Washington Roundup

Space Record Session

Special technical committee of the Federation Aeronautique Internationale will meet July 17 in Paris to study U. S. and Soviet claims for space records, based on the flights of Cdr. Alan Shepard and Maj. Yuri Gagarin, and to make recommendations for their homologation as official FAI records.

Russia submitted the minimum of factual data on Gagarin's orbital flight that is required as a result of the FAI Barcelona meeting last fall but presented it in an elaborate, hand-embossed leather folder. The mass of technical detail on Shepard's Mercury flight was presented in a plain mimeographed, stapled paper.

U. S. technicians on the committee will press for elaboration of some Soviet data—for example, a more precise answer on the thrust of the booster engines. All Russia said was that they produced 20 million hp.

U. S. representatives on the FAI sporting commission also will continue to press the Russians to submit pictures of aircraft for which records are claimed. The Soviet film strip that accompanied the world altitude record claim of 112,205 ft. for the E-66 shows an aircraft that looks suspiciously like the Lockheed F-104, which now holds the official record of 103,395 ft.

Soviet Russia has a delta-winged supersonic bomber in production and in operation. Three separate Soviet nuclear-powered submarines have been identified under way at sea by the U. S. Navy.

Joint Chiefs of Staff will testify on the detrimental effects of a continued nuclear test moratorium this week at a closed session of the Joint Congressional Atomic Energy Military Applications Subcommittee. Administration supporters in Congress are urging the President to end the voluntary ban.

Noise Effect Probe

Pressure is building for a broad congressional investigation of the effects of airports on surrounding communities. The noisier jets and longer runways have aggravated the problem. Focus now is on the House Rules Committee, which is considering a resolution by Rep. Richard E. Lankford directing the House Banking and Currency Housing Subcommittee to study effects of federal airport development on surrounding homes, with emphasis on the Federal Housing Administration's policy of refusing to insure mortgages on homes considered too close to airports.

Until now, House Interstate and Foreign Commerce Committee Chairman Oren Harris has refused to support special airways studies, preferring to keep this the province of his own committee. But one veteran of the Rules Committee told AVIATION WEEK: "If Oren doesn't do something about this jet problem on his own committee, I'm going to have to vote to let a select committee look into it."

Rep. Joseph P. Addabbo, whose district is on Long Island, said his constituents are so up in arms that he is afraid to go home for the summer. "First thing you know, somebody . . . is going to shoot down one of those jets flying over his house with a shotgun," he said. "We've got to do something."

Likely result: Rep. Harris will conduct his own special investigation.

Army Col. Earl G. Peacock is the new military consultant for the House space committee, succeeding Navy Capt. Howard J. Silberstein, who leaves the post next month. Col. Peacock served in the Office of Defense Research and Engineering and worked on Army's Lamp lunar base studies.

AFSC Vacancies

Air Force Systems Command has approximately 800 vacancies in its Ballistic Systems and Space Systems Divisions that cannot be filled for lack of qualified personnel. This example of the current gap in technically educated personnel was mentioned to Congress recently by Lt. Gen. Roscoe G. Wilson, USAF's deputy chief of staff for development. Gen. Wilson said "an enormous gap" is coming in the grades of senior captain, major and junior lieutenant colonel, and "in a matter of years it is going to be very difficult to find people."

Defense Department will be called before the House Armed Services Investigating Subcommittee, headed by Rep. Edward Hebert, next week to justify the mushrooming use of non-profit organizations. Fiscal 1961 payments by Defense for outside services exceed $100 million.

President's Committee on Equal Employment Opportunity is continuing to meet quietly with defense contractors in the hope of getting more anti-discrimination agreements, such as the one signed last month by Lockheed Aircraft Corp. Several companies met last week, primarily with committee staff members, and more will hold talks this week. Vice President Lyndon Johnson heads the committee.

—Washington Staff

Lunar Drive May Cost Under $20 Billion

NASA fiscal studies cut estimates from $40 billion; total includes all programs related to moon effort.

By Edward H. Kolcum

Washington—Crash program to beat Russia in landing a man on the moon, including all supporting research and development, may cost less than $20 billion instead of the $40-billion estimate made two months ago.

The total figure includes a number of vehicle and payload projects that already were on the schedule but that now have been incorporated into the Apollo manned lunar landing program because they will contribute background information to the mission. Among them are at least 20 scientific satellites and probes, and all advanced launch vehicles.

National Aeronautics and Space Administration is still analyzing the total program to determine how much under $20 billion it will cost, but because the detailed funding study will continue through the life of the program it is unlikely that the agency will commit itself to a specific figure. The new estimate takes into account an assessment of the comparative costs of alternate approaches and is being made with NASA's newly-installed computer analysis management system, a modification of Defense Department PERT/PEP procedures (AW June 12, p. 33).

D. D. Wyatt, director of the new NASA programs office told AVIATION WEEK that launch vehicle development, procurement and flight will cost about 50% of the total estimate. Spacecraft and systems will cost about 33%, and supporting science and technology 15%. Tracking will account for the remaining 2%.

Vehicle costs will cover procurement of Saturn, Nova, Atlas Agena B, Centaur and Little Joe. Also included is full development cost of Nova, Saturn C-2 and C-3 and an advanced Little Joe (AW May 22, p. 24), and a portion of the cost of developing Saturn C-1. Test stands and launch facilities also are charged against the moon program.

Spacecraft and systems category includes the complete cost of developing the Apollo A earth-orbiting laboratory, Apollo B circumlunar craft, Apollo C lunar landing vehicle and Project Mercury capsules from the 21st through 26th production versions. Additional Mercury capsules may be required for component development and bioastronautics studies.

The Apollo program will be charged with all Ranger, Surveyor and Prospector costs. Justification is that Ranger will sample the earth-moon environment, and Ranger and Surveyor will study the lunar atmosphere, surface and subsurface—all necessary stages prior to a manned lunar landing. Prospector will be the unmanned logistics vehicle to support a moon base.

Also in the supporting science and technology area are portions of the aeronomy satellite, designed to measure micrometeoroid hazards; the energetic particles satellite series, to assess cosmic particle flux and energies; the solar, astronomical and geophysical observatory satellites, which will provide long-term studies of the earth-moon environment and radiation effects.

The entire NASA biomedical program is charged to Apollo, and includes flight programs with Bios payloads (AW June 5, p. 23), studies to assess the need for variable gravity, and radiation effects on living tissues.

In the supporting science and technology program, flight schedules of experiments will be accelerated over the schedules in effect before the emphasis on Apollo, and some projects may be given additional flights.

The cost for tracking will cover modification of the existing Project Mercury network.

Wyatt said that the method used in estimating the cost and extent of the manned lunar landing program is "to include all projects required to produce the information we need," even if the projects were approved and funded before the Apollo emphasis. Cost estimates were made by NASA research and development personnel, and the refined figures are possible because the agency is in a better position to "price out" the costs of parallel approaches, he said.

Early decisions on selecting a single approach can keep the total program costs down, but NASA recognizes that the validity of its funding estimates is complicated by the unknown political climate that will prevail when alternate projects are eliminated.

The agency now is in the process of determining those areas where alternate approaches must be considered because of their technical difficulties. Among them are launch vehicles—solids vs. liquids—and flight techniques—direct launch or launch from orbit. Alternate vehicle concepts include assessment of the newly conceived Saturn C-3 (see box) as a rendezvous vehicle, and comparing it with Nova using direct ascent.

Wyatt said NASA's cost estimates in the past have been close to those of industry, despite the unknowns that predominate in the agency's contracts. The primary factor in arriving at a reasonable estimate, he said, is the number of man-years of work involved, not the dollar figure.

The fact that all space programs which will contribute to the manned lunar mission have been incorporated into the over-all Apollo program has

Saturn C-3 Approved to Launch Apollo B

Washington—Saturn C-3 launch vehicle proposed by Marshall Space Flight Center (AW June 12, p. 58) has been approved by the National Aeronautics and Space Administration as the vehicle to launch the Apollo B circumlunar spacecraft.

Maj. Gen. Don R. Ostrander, NASA launch vehicles director, said the C-2 is "rather marginal" for the mission, and the agency wants to start development early next year on the C-3. The new Saturn consists of a cluster of two Rocketdyne F-1 engines as booster, four Rocketdyne J-2 engines as a second stage, and six Pratt & Whitney LR-115 engines as third stage.

NASA meanwhile has narrowed the list of prospective bidders for the J-2 stage to Aerojet-General Corp., Douglas Aircraft Co., General Dynamics-Astronautics and North American Aviation. They will meet June 21 at Marshall for a bidders conference. Proposals will be due Aug. 1. Contract for the stage will be awarded Oct. 1.

Gen. Ostrander also said NASA is planning to seek industry proposals for the S-1 Saturn first stage to accelerate its availability. The stage has been built by the government at the Marshall facility.

After an announcement by Rep. Overton Brooks (D.-La.), chairman of the House space committee, NASA confirmed it was considering a site at Michoud, La., as a possible Saturn construction facility. The site, near New Orleans, is a former Army ordnance plant.

NASA said it is inspecting sites throughout the country as potential Saturn construction facilities. The agency plans to assign the selected facility to a contractor.

not been explained previously by the White House or NASA. Because they will become a part of Apollo, these programs will share the top national priority. But because they increase the dollar cost, NASA will be under heavy pressure to justify its plans, and to be successful in space shots.

Saunders B. Kramer of Sunnyvale, Calif., a space scientist, told AVIATION WEEK the NASA cost estimate for the lunar mission is "ridiculously high." Kramer said the mission can be accomplished by 1967 at a cost of $4 billion.

He added that the manned circumlunar mission of Apollo B is wasteful and should be eliminated, and suggested that the Saturn C-2 be used for rendezvous and the Apollo vehicle be launched from orbit. Instrumented packages and animal payloads, he said, should be flown instead of men in the circumlunar phase.

Kramer's estimate includes $2 billion for development of the spacecraft, but does not charge vehicle development and supporting technology to the mission cost.

Public reaction to President Kennedy's request for accelerated moon project spending (AW May 29, p. 25) has been mixed in the press and largely favorable in correspondence from the public to the President. Members of the Senate and House space committees say there has been no significant increase in their mail on the moon program since the Administration message.

Although the majority of letters received by the White House and NASA on the subject of the moon program are favorable, there is some misunderstanding of the cost, according to Dr. Edward C. Welsh, executive secretary of the National Space Council.

The President has received suggestions for financing the program ranging from bonds for space to outright offers for contributions.

Dr. Welsh said the misunderstanding in economics stems from a belief that the six-year, $30-billion projected cost of the total U.S. space program is wrongly considered a one-year program. He said it is not generally understood that the program does not average more than 1% of the gross national product.

Congress and NASA are emphasizing prestige, national security, byproducts and the effect on the economy in defending the cost of the space program.

Press reaction since President Kennedy's space increase request, May 25, has been divided, but some influential newspapers have been highly critical in editorial analyses.

Some of the adverse comment accuses the President of failing to make a strong case for the expenditure, and questions the practical utility of a manned lunar base unless it can be used for military defense.

Senate Space Group Favorable To Higher NASA Fund Requests

Washington – Senate Aeronautical and Space Sciences Committee has concluded hearings on President Kennedy's bolstered space budget requests without raising any serious objections.

The tone of the hearings—never attended by anything near the full committee complement of 15 senators—was one of general inquiry rather than detailed analysis of the President's money requests. There were few expressions of doubt about the merits of the proposals.

An exception to the general mood of approval came on the last day of the hearings when Chairman Robert S. Kerr (D.-Okla.) said the Air Force Dyna-Soar program appears to "duplicate" the work of other space projects. But Sen. Kerr told AVIATION WEEK he will not recommend cancellation of Dyna-Soar or suggest its review by the Senate Armed Forces Committee.

Sen. Kerr contended during the hearing that the National Aeronautics and Space Administration's manned space flights will provide the same information to be gathered with Dyna-Soar. He stuck to this view despite counter arguments by Harold Brown, director of defense research and engineering, and by Maj. Gen. Victor R. Haugen, Air Force assistant deputy chief of staff, development.

Brown said the initial phase of the Dyna-Soar project "is to develop and demonstrate . . . materials in vehicles boosted by Titan II and able to be controlled aerodynamically." He said the fine and control surfaces and other materials developed under Dyna-Soar could be attached to other space vehicles. "Therefore," Brown said, Dyna-Soar "competes with all" space projects "but is an addition to all of them." He added that Dyna-Soar holds promise for space rescue missions.

As for technological problems confronting development of a space plane, Gen. Haugen said because of progress with such materials as titanium, nickel-based alloys and ceramics, "we're not too concerned anymore with the abilities to cope with the very high temperatures" which will be encountered.

Brown also discussed these other projects:

- **Solid segmented rocket** program through the final ground test will cost $250 million. Brown said it will take three years to get a "thorough test."
- **Advent communications satellite** "must be able to operate in a military environment and should be secure," therefore, it is "unlikely" the Advent satellite will be used "even partially" for non-military communication.
- **Development work** on the Vela Hotel project for detecting nuclear explosions is "not dependent" on the Geneva disarmament negotiations.
- **The "only possible justification"** for bigger military boosters than those planned is to "make an attack more certain of penetrating."
- **NASA and the Defense Department** "under the aegis of the space council" will decide on the relative merits of liquid and solid propellants for big boosters. Brown added that "in matters involving this large an expenditure," the President will have to make the decision. "Within two years or perhaps three," he said, "we'll know which is better for what purpose."
- **Landing a man on the moon** will be "part of a more general program of manned exploration of the solar system—but will be an important milestone."
- **X-15** airplane "will not go much faster than 3,500 mph.

The House passed its space authorization bill May 24, one day before President Kennedy submitted his message asking for more money (AW June 5, p. 26). So the House-passed bill probably will be amended to include the increases and conform with the Senate version. Chairman Overton Brooks (D.-La.) of the House Science and Astronautics Committee told AVIATION WEEK he may hold authorization hearings on the President's new money requests, but will not make a decision until he reviews the Senate space hearings.

Lunar Landings

Los Angeles—Cost of about $10 billion for a U.S. program to land a man on the moon was estimated last week by Trevor Gardner, chairman of the USAF Space Committee, at a joint meeting of the American Rocket Society and The Institute of the Aerospace Sciences.

Gardner raised the question of who should manage the program—NASA or Defense Department. Though he did not follow with a specific recommendation, he said the experience of such men as Gen. Bernard A. Schriever and Adm. William F. Raborn in directing USAF's former ballistic Missile Division and Navy's Special Projects Office for Polaris should be utilized.

Concurrency, as developed in the Atlas, Titan and Minuteman ICBM projects, must be exploited to the fullest in the lunar program, he said.

Fiscal 1962 Missile and Aircraft Procurement

Congress authorized this Fiscal 1962 program last week. Funds already on hand will partially finance the Air Force and Navy aircraft programs and the Navy missile program.

AIRCRAFT

	Quantity	Authorization (in millions of dollars)
Air Force		
SAC long-range bomber	....	$525.0
KC-135 jet tanker	....	230.0
F-105D tactical fighter	....	369.9
T-38 jet supersonic trainer	144	128.9
T-39 jet utility trainer	55	50.3
T-40 mission support	10	19.1
B-70 supersonic bomber	4	218.0
RF-105 tactical reconnaissance	....	27.5
RC-130 mapping and charting	....	7.4
C-130E airlift transport	83	236.7
C-141 airlift transport	....	98.0
Long-range passenger transport	1	8.0
C-135 turbofan engines, to replace C-135 turbojet engines	15	21.2
Guided air rockets	....	40.2
Modifications (millions)		671.9
B/RB-47	$3.0	
B-52	260.0	
B-58	18.5	
RC-121	3.3	
C-124	3.1	
C-130	3.5	
KC-135	5.5	
F-100D, F	9.7	
RF-101	8.9	
F-102	5.5	
F-105	50.7	
Other	28.7	
Class IV kits	173.0	
Interceptor improvement package	78.5	
Military assistance program	20.0	
Common in-service aerospace ground equipment		82.7
Component improvement		46.7
Industrial facilities		23.0
Replenishment spares		1,270.0
All other		26.6
Air Force Total		4,101.1
Navy		
A4D-5	180	
A2F-1	24	
F4H-1	88	
F8U-2N	72	
HU2K-1	48	
HSS-2	42	
HUS-1	70	
P3V-1	36	
S2F-3	48	
W2F-1	12	
HRB	14	
T-39	10	
Total		1,180.5
Advance procurement		10.0
Aeronautical spare parts		421.1
Modernization		50.0
Training equipment		11.2
Industrial facilities		5.0
Navy Total	644	$1,677.8
Army		
L-23F Seminole	14	1.8
AO-1 Mohawk	48	42.8
AC-1 Caribou	48	30.2
HU-1B Iroquois	242	67.6
HC-1B Chinook	24	35.4
Spare parts, installation kits, etc.		33.2
Army Total	376	211.0

MISSILES

Air Force	
SM-65 Atlas ICBM	201.6
SM-68 Titan ICBM	1,129.8
SM-80 Minuteman ICBM	923.8
GAM-77 Hound Dog	131.4
GAM-83 Bullpup	16.3
TGAM-83 Bullpup	10.4
Q-2C Drone	10.9
Ballistic missile support (millions)	180.0
Atlas, total $45.6	
Airborne spares 14.6	
Ground spares 31.0	
Titan, total 58.6	
Airborne spares 24.2	
Ground spares 30.3	
Tools and test equipment 4.1	
Minuteman, total 75.8	
Airborne spares 38.6	
Ground spares 32.3	
Tools and test equipment 4.9	
Modifications	25.0
In-service support	22.8
Component improvement	4.0
Industrial facilities	14.0
Classified	122.0
Air Force Total	2,792.0
Navy	
Missile procurement: Sparrow III, Sidewinder 1C, Terrier, Tartar, Talos, Bullpup, Regulus I, Subroc	246.4
Target drone procurement: Q2C, KD2B, KD2 R-5, F9F-6K conversion, Tow targets, KD2U boosters	29.1
ASW drone helicopter	8.7
Polaris ballistic missile	354.4
Industrial facilities	1.0
Astronautics	4.8
Navy Total	644.4
Army	
Missiles: Nike Hercules, Hawk, Redeye, Honest John, Little John, Anti-tank, Sergeant, Pershing	550.8

USAF, Navy Criticized on Aircraft Buys

By Katherine Johnsen

Washington—Air Force and Navy have been severely criticized for separately working out programs for major purchases of utility support aircraft, involving hundreds of aircraft and a total of $500 million—or more.

House appropriations subcommittee members said that the services approached the program quietly on a piecemeal basis failing to coordinate plans, and they suggested that contractor preference was an influencing factor in the selection of aircraft. Appropriations subcommittee hearings on military procurement were released last week.

Rep. George Mahon (D.-Tex.), chairman of the subcommittee, called the procedure "mismanagement at its worst" and urged the office of the secretary of defense to work out a single coordinated program "that can be defended," with particular emphasis on future maintenance and operations costs. He observed to Thomas D. Morris, assistant secretary of defense for supply and logistics:

"If you represent that agency in the Defense Department that is supposed to coordinate procurement procedures and move toward more efficiency and economy, it seems to me here is a good place to put your foot down and decide, after conferences with all the services, officially which way we move."

Air Force Plan

Air Force's program, now pending before the secretary of defense, calls for 226 Lockheed C-140 JetStars to replace obsolescent C-54s and C-47s. USAF bought five C-140s in Fiscal 1959 for Airways and Air Communications Services. An additional six were ordered for procurement for executive use last December, with funds made available through reprograming and without advance notification to the congressional appropriations committees.

Ten "T-40s"—a trainer designation for the JetStar—are included in the Administration's Fiscal 1962 USAF budget. At House appropriations hearings, USAF acknowledged that these 10 aircraft would be "ordered and delivered as the C-140 type" to replace C-54s and C-47s.

The Navy program, now pending before the secretary of the Navy, proposes replacement of approximately 200 Douglas R4D aircraft—Navy designation for the USAF C-47—with Grumman Gulfstream types. Vice Adm. R. B. Pirie, deputy chief of naval operations for air, refused at two points to disclose to the subcommittee the replacement recommendation that had been made to the Navy secretary.

Mahon commented that "for the present, I do not care to make a point," but a "Navy Statement on Transport Aircraft" from an unnamed source was subsequently inserted in the record. It was an evaluation favoring the Gulfstream over the Fairchild F-27. Adm. Pirie said Navy wants to reprogram funds this summer in order to start procurement of the R4D replacement in Fiscal 1962 with a purchase of "two or three" aircraft.

According to USAF figures, the unit flyaway cost of the three competing types is: C-140, $1.5 million; Gulfstream, $1.1 million; F-27, $1 million.

In response to congressional allegations of contractor favoritism and that USAF and Navy were making and planning small orders—before the over-all replacement program had been officially agreed upon—"in order to improve the financial status of the producer," Lt. Gen. Mark Bradley, USAF deputy chief of staff for materiel, commented:

"You have four or five companies with very little work in them, and three or four people with a prototype or two and a small commercial order, and all of them are trying to somehow sell enough airplanes to the services to break even. I think that you will find Grumman, having been a Navy plant over the years, the Navy naturally would tend to try to fill their requirement with their plant. Certainly the Air Force would probably feel the same way, and in all honesty, I think this is a problem of the services getting together. If there were plenty of airplanes, it would probably be pretty easy to settle on one, but there aren't many airplanes being bought."

Meanwhile, Congress completed action last week on legislation authorizing over $9.6 billion in new funds for aircraft and missile programs. All funds asked by the Administration were approved, plus three additional programs: $525 million for B-52 Strategic Air Command bombers, $21.2 million for turbofan engines for Military Air Transport C-135 aircraft and $8 million for a long-range jet transport for the President.

No B-70 Acceleration

The authorization represents the maximum amount that can now be implemented with appropriations. This means an acceleration in the B-70 Mach 3 bomber program—ardently urged by Air Force—is out. Congress authorized only the $220 million Fiscal 1962 development program of the Administration.

With this development, Air Force witnesses before the House appropriations subcommittee appeared anxious for B-52 bomber funds, and outlined a program of purchasing 52 additional aircraft for $525 million. With output scheduled at four per month, this would keep production at the Boeing Wichita plant going until March, 1964.

Congress appears likely to vote the $525 million in appropriations for the B-52 order. Secretary of Defense Robert S. McNamara stated to congressional committees that he would leave the decision on additional B-52s to the President. At a press conference, he said he would recommend against it.

Other highlights on defense procure-

Soviets Practice for Major Air Show

Moscow—Soviet air force is expected to stage its first major military air show in five years on July 9, probably at Tushino Airport, in observance of Soviet national aviation day.

Large numbers of Russian air force aircraft have been practicing over the Tushino area recently. Soviet Patriot, publication of the DOSAAF Central Committee, has urged units of the flying organization to take "an active part" in preparation for the holiday.

Typical day's practice in the past two weeks has included this flying sequence:

- **Mi-1 and Mi-4 helicopters fly over in formation. Transports execute paradrops, apparently of both men and cargo. Aerobatics are performed by single aircraft of these types: MiG-19 (Farmer); Su-16 (Fishbed), MiG-21 (Faceplate), MiG of the type which NATO calls Fitter, and MiG-17 (Fresco).**
- **Separate formations of the following types totaling about 125-aircraft flyby: Tu-20 (Bear) bombers; Tu-16 (Badger) bombers; MiG-17s; Yak-25 (Flashlight) all-weather fighter; Su-15 (Fishpot); Su-16s and MiG-21s.**

Speculation here on why the military flights are being resumed after a five-year break includes the possibility that it is an attempt to compensate for the lack of Soviet military participation in the recent Paris Air Show and the possibility that it is intended as a reminder of Soviet military strength. It is expected that Western observers will be invited to the Soviet show.

ment programs developed at the House appropriations hearings include:

• **New IRBM.** Air Force is now conducting studies on a new intermediate-range ballistic missile, even though definite phase-out dates for Thor and Jupiter have not been established. According to Maj. Gen. Bruce K. Holloway, director of operational requirements, deputy chief of staff, operations, USAF has rejected an adaptation of Minuteman, Army's Pershing, or Navy's Polaris. Holloway added:

"We have looked at various hybrids, mixtures of these three. Each time we have looked at it, which has been done pretty thoroughly, we conclude that a new missile would make more sense, and, in the long run, not very long run, would be more economical and more reliable. Primarily the reason for this conclusion is that we now know how to build a guidance system which would be much improved over any of those that could be adapted to an IRBM type."

• **Mobile Minuteman** stretch-out. The stretch-out of the mobile Minuteman program will be of "a very great magnitude," according to Maj. Gen. Thomas P. Gerrity, commander of Ballistic Systems Division, Air Force Systems Command. With no new funds for Fiscal 1962, USAF is now stretching $85 million in Fiscal 1961 funds—a large part of it presumably already spent—to run through Fiscal 1962.

USAF reported that $85.7 million has been devoted to date to the controversial mobile program, including: Boeing Co., $42.1 million; Autonetics Division of North American Aviation, $29.6 million; Avco Corp., $100,000; Aerojet-General Corp., $1.6 million; Hercules Powder Co., $1.5 million; Thiokol Chemical Corp., $6.9 million; railroad rolling stock, $900,000; construction, $3 million.

• **Titan ICBM.** A program to modify six Titan I squadrons to improve reliability is under consideration by Air Force. USAF reported "a dramatic improvement in reliability" in progressing from Titan I to Titan II.

Air Force insisted that action taken last Fall by Martin Co.—with USAF support—to bring new management into the Titan I installation and checkout program will actually result in a lower over-all cost to the government. The four new subcontractors to Martin which took over management functions related to installation and checkout were: Norair Division of Northrop Corp., RCA Service Co., Federal Electric Co. and Hughes Aircraft Co.

Gen. Gerrity reported that in the Titan II program, "as it now appears, the Martin Co. will handle that entire program."

Gen. Gerrity said that outside management was not necessary in the Convair Atlas program "since the Atlas sites in the initial phases moved more slowly" and Convair "had more time to mobilize the build up of this management experience." Becaues of the comparative simplicity of Minuteman, and Boeing's experience with Bomarc, Gen. Gerrity said there would be no requirement for outside management in installation and checkout.

• **Hound Dog delay.** Research and development testing, scheduled for completion in late 1960, was delayed while USAF made over 100 "significant" but "not cataclysmic" changes in the guided air missile. The testing is now under way, and "so far very encouraging," Gen. Holloway said. Reporting that "trouble" started developing late last summer, he commented:

"The guidance system proved not to have the reliability we had hoped, it did not have the accuracy we had hoped, they both sort of go together to degrade the over-all effectiveness."

• **Navy aircraft.** As of Apr. 30, Navy had a backlog of 1,141 undelivered aircraft on order amounting to approximately $1.8 billion. The backlog was with eight companies: Grumman Aircraft Engineering Corp., $391 million; McDonnell Aircraft Corp., $362 million; North American Aviation, $296 million; Lockheed Aircraft Corp., $268 million; Douglas Aircraft Co., $153 million; Sikorsky Aircraft Division of United Aircraft Corp., $140 million; Chance Vought Aircraft, $133 million; Kaman Aircraft Corp., $52.7 million.

NATO Council, Belgians Support European F-104G Production Plan

By Cecil Brownlow

Geneva—European production program for the Lockheed F-104G interceptor scored a major gain in Paris last week and handily averted what could have been a major setback in Brussels.

In Paris, the North Atlantic Council, day-by-day ruling body of the North Atlantic Treaty Organization, formally approved the over-all European F-104G project as a "subsidiary body of NATO." Approval, which could help slash red tape delays and should reduce European production costs, encompasses the 949 F-104Gs scheduled to be produced in Europe on a four-nation basis as well as the 400 aircraft the U. S. plans to provide Denmark, Norway, Greece and Turkey through Mutual Assistance grants.

In Brussels, the Belgian defense minister met with members of the Socialist Party, a strong minority in the present parliament, and firmly rejected their demands that Belgium withdraw completely from the F-104 production program.

The Socialists, who make up 39% of the representation in parliament as a result of the March elections, strongly oppose the project on the grounds that it represents too great an outlay of funds and that no new aircraft for the Belgian air force are needed.

Defense Minister P. W. Segers replied just as strongly that the Belgian air force is badly in need of a replacement for its obsolescing fleet of Republic F-84s and Canadian Avro CF-100s and that the program is too far along to entertain any thoughts of cancellation. Segers pointed out that contracts for production have been signed, that Belgian firms already are tooling to do the job and that the program as a whole represents a boon to the nation's aviation industry.

As a member of the European production team, Belgian industry—principally Societe Anonyme Belge de Constructions Aeronautiques (SABCA) and Avions Fairey—will build a total of 182 airframes, and Belgian FN works will play a leading role in the licensed production of the General Electric J79 turbojet powerplant for the F-104G.

Belgium itself will receive 100 of the aircraft, 25 of which will be financed by U. S. Mutual Aid funds. The remainder will go to West Germany whose industry has not yet rebuilt to the point where it can effectively handle the 604 F-104Gs its government plans to receive from the European production program.

Belgium made an earlier threat last fall to pull out of the program while production plans were still being drafted. Principal reason behind the threat was the Belgian government's resentment of active U. S. support of United Nations efforts in the newly independent Republic of Congo. Officially, however, the Belgian government contended that any withdrawal would be the result of economic considerations based on severe economic straits resulting from loss of the Congo.

The F-104 joins the European production program for the Hawk ground-to-air anti-aircraft missile as a "NATO subsidiary body," and U. S. officials hope to gain agreement to give similar status to the air-to-air Sidewinder missile and the M-34 torpedo projects. Under present plans, the Sidewinder and M-34 are to be built in Europe under agreements signed separately by the individual nations involved.

NASA Will Convert Navy Barge To Transport Saturn Booster

Washington—Saturn booster will be barged down the Tennessee River, portaged 1.1 mi. around the recently-damaged Wheeler Dam, then loaded on a renovated Navy lighter for transportation to the Atlantic Missile Range.

National Aeronautics and Space Administration's Marshall Space Flight Center last week decided that this method of transportation is more feasible than moving the 50-ton, 82-ft. booster 50 mi. by road to pass the dam.

A lock in the Wheeler Dam shifted and broke early this month (AW June 12, p. 36), and NASA has been discussing the Saturn transportation problem with the Tennessee Valley Authority, Army Transportation Corps and Army Corps of Engineers. The dam is on the direct barge route from Marshall's Huntsville, Ala., facility to the Atlantic Missile Range, and several months will be required for repairs.

The Navy lighter, designated YFNB-33, has been in the Atlantic Reserve Fleet Group, Green Cove Springs, Fla. It is 261-ft. long with a 48-ft. beam, and it was towed last week to a dry dock in Jacksonville, Fla., where one end will be removed from the deck house.

The covered lighter is unpowered and will require towing. Marshall will install portable equipment to control the atmosphere within the tanks. NASA said the lighter will be ready for service and in place at Wheeler Dam by mid-July.

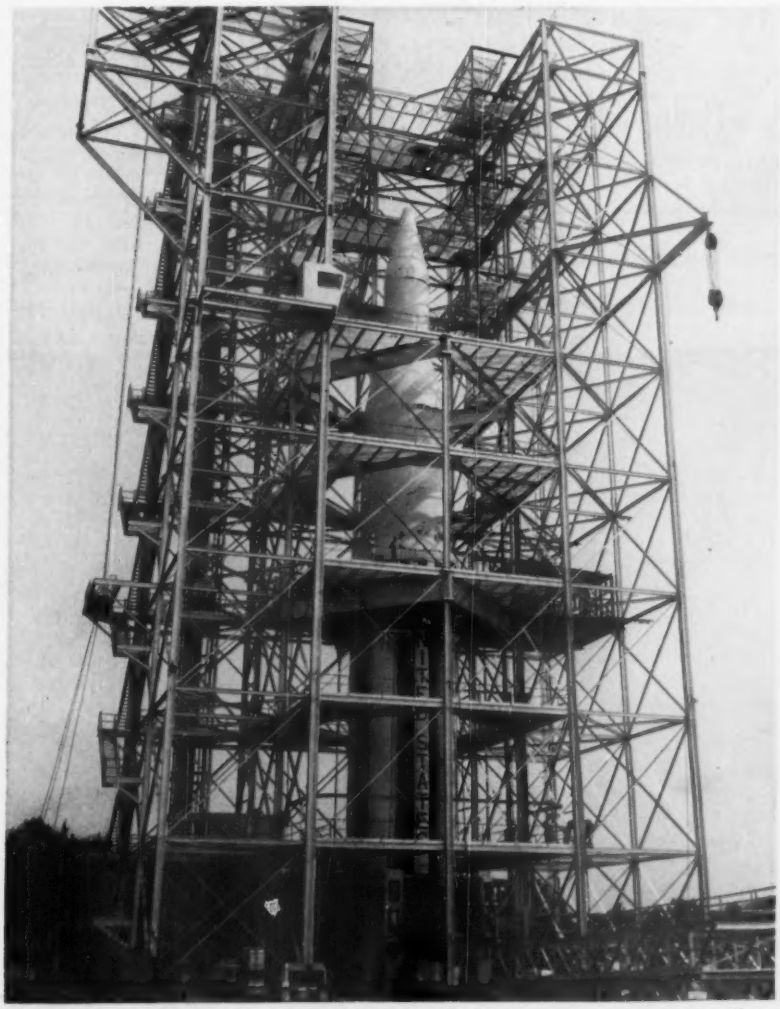
The Saturn barge Palaemon will transport the vehicle from Huntsville to the dam.

NASA had scheduled the first test flight of the Saturn vehicle in July, but the test now is expected in October. The flight booster, designated SA-1, will leave Huntsville in mid-August.

Meanwhile, NASA has awarded a $440,140 contract to the Arthur D. Little Co. to study the blast effects in the event of a Saturn failure. The study includes 50 detonation tests at Edwards, Calif., using propellant sizes up to 0.04 of the Saturn C-2 propellant capacity.

The government will furnish propellant for the study, which includes analyses of blast, pressure and time, size, temperature and direction of the fire ball, shockwave velocities and sound pressure levels. The study must be completed in four months, with a rough report due 30 days later and a final report due 30 days after the preliminary report.

NASA has requested proposals for a $1-million assembly, mating and checkout structure adjacent to the AMR Saturn docking area. The building will be 100-ft. wide, 250-ft. long and 50-ft. high, with a 40-ft. by 250-ft. shed at the south end.



FIRST FLIGHT configuration of the Saturn C-1, with dummy upper stages, is erected on dynamic test stand at NASA's Marshall Space Flight Center, Huntsville, Ala. The 163-ft. vehicle was placed in the 204-ft. tower to check mechanical mating of the stages, bending characteristics and effect of simulated flight vibrations on the complete space booster. Fueling exercises will also be conducted.

Bullpup Second Source To Be Ready in 2 Yr.

Washington—Establishment of a second production source for the Navy-Martin Bullpup air-to-ground missile is expected to take 1½-2 years.

Air Force interest has increased the program to the extent that the Navy feels there should be a second production plant in case one should be destroyed in an attack.

Navy was successful in establishing second source production with its Sidewinder air-to-air missile program. Navy also found that opening a second source was effective in reducing costs.

The Martin Orlando Division is now transmitting drawings to the second source contractor, the Maxson Electronics Corp.

A departure from usual practice will occur after Maxson has been in production for a year on the low-price missile. Then the Navy will ask for bids from both Maxson and Martin, and the lowest bidder will get about 75% of the business for the subsequent year.

First firing of the GAM-83A, the Air Force version, from a Republic F-105 was completed recently over the Gulf Missile Range, Eglin AFB, Fla. It was the first in a series of qualification tests for the Bullpup/F-105 system.

Offshore Nova Launch Facility Studied

By Irving Stone

Los Angeles—Proposals are due June 19 in a competition sponsored by NASA's Marshall Space Flight Center for a top-priority, 15,000-man-hour study for an offshore launch facility to accommodate the 12 million-lb.-thrust first stage of the Nova vehicle.

The launch site is projected to be 10 to 15 mi. out in the Atlantic Ocean off Cape Canaveral, because the explosive and acoustical hazards associated with the huge Nova vehicle require a large separation distance between the launch facilities and civilian communities.

Proposals in a similar competition for the Saturn C-2 boost vehicle (AW May 8, p. 58) have been shelved temporarily in favor of the Nova facility, which apparently could accommodate the considerably smaller Saturn booster.

Magnitude of the design and construction task for the Nova offshore launch facility is underscored by the vehicle's size. One version, presumably the maximum size Nova, is a six-stage configuration more than 396-ft. high, tapering from a diameter of 65 ft. at the booster base to 15-ft. diameter for the top stage. This configuration still is not firmed as a design, but is projected to incorporate these propulsion units:

• **First stage,** developing 12 million lb. thrust, is composed of a cluster of eight Rocketdyne F-1 engines which will be fed by 6.4 million lb. of RP-1/liquid oxygen propellant. Estimated dry weight of the stage is 550,000 lb. The first stage cluster will be 65 ft. in diameter, have a height of 80.58 ft. to the top of the cluster.

• **Second stage** will be a pair of F-1 engines, will be fed by 1.6 million lb. of RP-1/liquid oxygen and have a dry weight of 110,000 lb. Stage diameter is 26.67 ft., height 80.58 ft.

• **Third stage** will be composed of a cluster of four Rocketdyne J-2 engines, each developing 200,000 lb. thrust, for a total of 800,000 lb. thrust for the stage. Propellant load for the stage will be 700,000 lb. of liquid hydrogen/liquid oxygen. Stage dry weight is estimated to be 40,000 lb. Diameter is 26.67 ft., and the height is 93.33 ft.

• **Fourth stage** is a single J-2 engine fed by 190,000 lb. of liquid hydrogen/-liquid oxygen. Diameter is 18.33 ft., height is 60.08 ft.

• **Fifth stage** is projected to be a cluster of six Pratt & Whitney LR-115 engines (Saturn S-IV stage) each developing 15,000 lb. thrust, for a total of 90,000 lb. Propellant load for this stage will be 100,000 lb. of liquid hydrogen/liquid oxygen. Stage diameter is 18.33 ft., height is 36.16 ft.

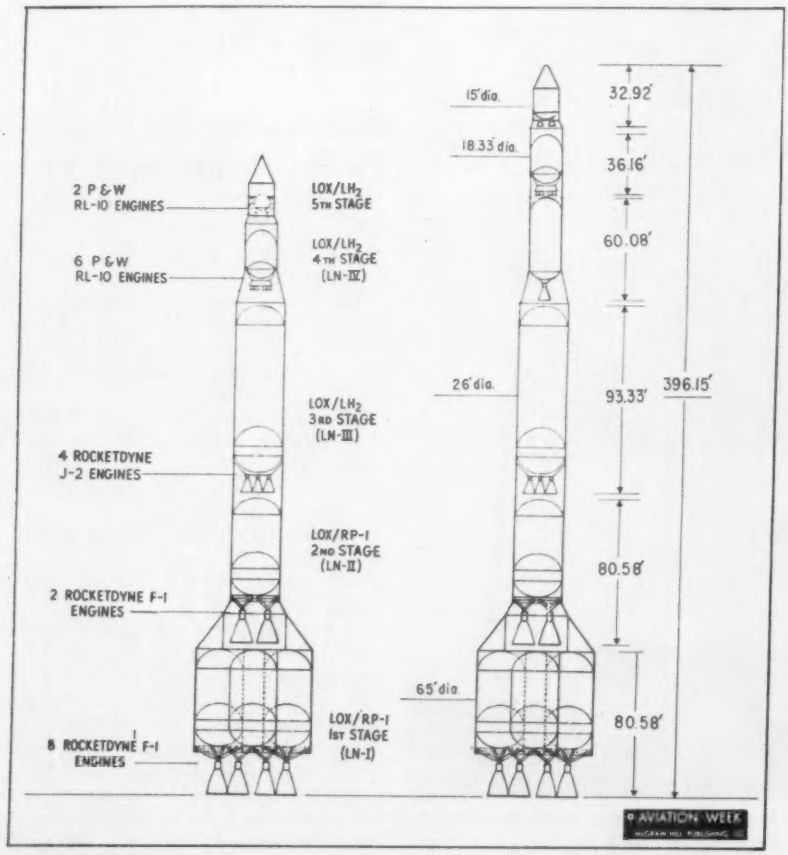
• **Sixth stage** will be a pair of liquid hydrogen/fluorine units fed by 22,000 lb. of propellant. Diameter is 15 ft. and height to the tip of the space vehicle above the stage is 32.92 ft.

Nova is a modular concept calling for various staging combinations. NASA has requested $48.5 million to begin development of a 4-stage Nova vehicle and conceptual studies are under way for a five-stage vehicle.

As described in Washington by Maj. Gen. Don R. Ostrander, NASA launch vehicles director, to the Senate Space committee last week:

• **NASA 4-stage Nova** will consist of eight F-1 engines clustered for the first stage; two F-1s clustered for the second; four J-2s clustered for the third, and six LR-115s for the fourth.

• **NASA 5-stage Nova** will have the same four stages with a cluster of two LR-115 engines for the fifth stage.



TWO CONCEPTS for NASA's Nova space booster show modular concept variations. Six-stage vehicle is apparently the largest contemplated. NASA also has studies under way for the five-stage vehicle.

Air Force Nova

Air Force also will develop a Nova to NASA specifications with a solid propellant booster and possibly a second solid stage. Third and fourth stages would be the same as the NASA 4-stage vehicle.

Estimated total on-board propellant load for the 6-stage Nova is expected to be 9,012,000 lb. Estimated total pressurizing gas requirements for the vehicle will be 750,000 gal. of liquid nitrogen and 60,000 gal. of liquid helium.

The 1.5-million-pound-thrust F-1 engine is programed for preliminary flight rating tests to be completed in 1963. All major components have entered the test phase during fiscal year 1961, and hardware for the first three engines is now being fabricated. During Fiscal 1962, thrust chamber tests are projected to be conducted at full power for durations up to 20 sec. Full duration planned for the engine is 150 sec.

First test of a complete Rocketdyne J-2 engine system is programed for fiscal year 1962. Preliminary flight rating test is scheduled for early 1963, and qualification is scheduled for mid-1964.

Research on the basic problems asso-

Bambi Fund Allocated

Los Angeles—After successive reviews, funding allocations for feasibility studies in Air Force's Project Bambi—ballistic missile boost intercept—includes $1.25 million each for Space Technology Laboratories and Hughes Aircraft, and probably a slightly higher amount for Convair. Convair and STL will perform system studies, with Hughes performing work in subsystem areas such as infrared search and track and closing engagement. There is a possibility that Hughes also may be given an assignment for the satellite's interceptor vehicle study along lines devolving from its extensive Falcon missile development.

ciated with a liquid hydrogen/fluorine engine is being conducted at NASA's Lewis Research Center.

The concept for the offshore Nova launch facilities envisions a total requirement for three launch pads. These could be located on fixed, above-water structures, on man-made islands, Texas Towers or drydocks floated to position and anchored, or in below-water caissons. In each case, an umbilical tower will be required, together with a compatible fixed, semi-fixed or movable service structure.

Projection is that the launch control center, booster vertical assembly and checkout building and other necessary technical supporting buildings will be located on the Cape mainland. The booster assembly building is planned to accommodate a minimum of three assembly bays, with a possibility for expansion to six bays. Upper stages will have to be assembled and checked out on the launch pad.

Other Basic Factors

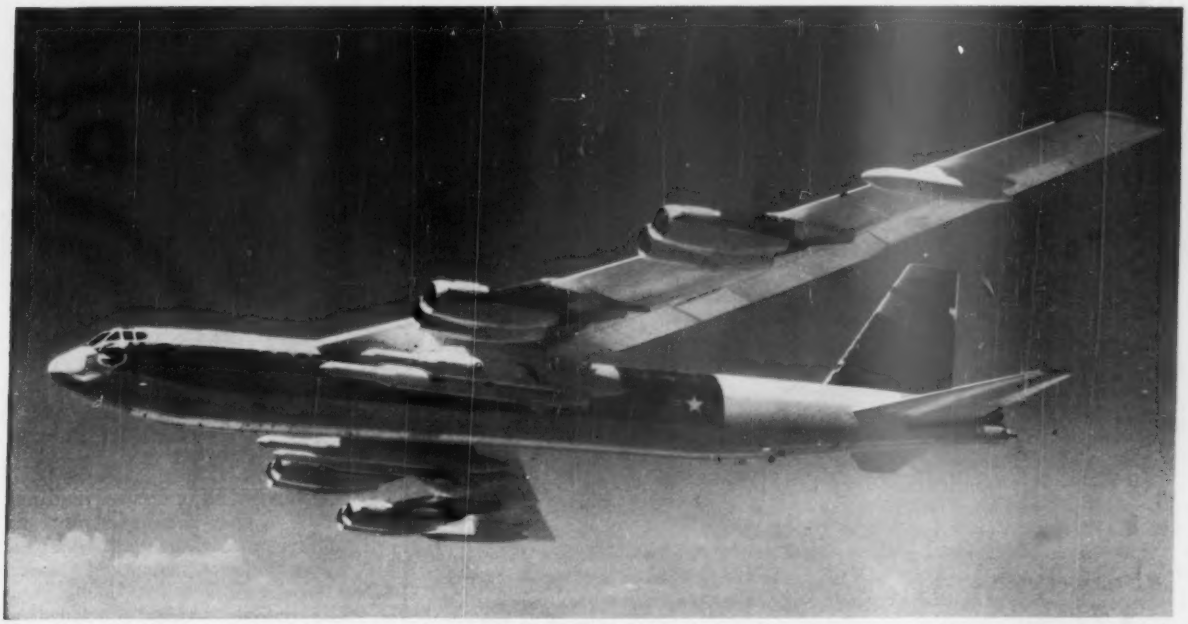
Other basic factors involved in the offshore launch concept for Nova will include:

- **Transportation of vehicle stages,** components, equipment, personnel and supplies from the Cape to the offshore launch pad. Transportation systems may involve causeways, barges, boats, or helicopter modes.
- **Hurricane and environmental** protection for the vehicle on the launch pad. All structures and buildings will have to be designed to withstand winds up to 125 mph. Vehicle stages also will have to be protected during the critical logistic phases.
- **Propellant storage,** transport and replenishing barges. Mounting of cryogenic production facilities on waterborne vessels will be considered, along with underwater or floating-tank storage of RP-1 fuel.
- **High-pressure** gas storage and transfer systems.
- **Land-based** versus offshore electrical powerplant locations.
- **Camera and tracking** facilities which may be required near the pad.
- **Support facilities** for 500 to 800 workmen at the launch pad during work shifts. Standby crews will require quarters, while others will commute to the mainland.
- **High** cost of marine construction will require prefabrication on land for components of the offshore structure.

In the concept developed for the Nova offshore site, consideration will be given to the possibility of incremental construction of major facilities such as assembly building, transportation equipment and launch pads. Because of the magnitude of the funding requirements for the program, incremental funding for construction of the facilities will be an important consideration.

Titan-Mercury Studied

Officials of the NASA Space Task Group will visit the Martin Co.'s Denver, Colo., plant late this week to investigate use of Titan I and Titan II ballistic missiles as boosters for interim manned space flights between the present Mercury program and the projected Apollo program. The spacecraft would be a modified one-man Mercury capsule and would probably be heavier to accommodate new research instruments and flight control equipment. NASA officials deny that Titan is being considered as a booster for any missions now included in the Mercury program. They say it would require 10 months to prepare the missile for Mercury missions.



B-52H Makes Test Of Skybolt Compatibility

Compatibility flight test, mating the Boeing B-52H with Douglas Skybolt missile test shapes, is made from Boeing's Wichita, Kan. plant. Earlier trials were made with test Skybolts slung from a B-52G testbed configured to a B-52H (AW Jan. 30, p. 103). The new H-model bomber will carry four long-range, hypersonic nuclear-tipped ballistic missiles in addition to nuclear weapons in the bomb bay. Defensive armament includes a 20-mm. cannon firing 4,000 rounds a minute.

Explorer VIII Data Analysis to Show Electrical Drag Effect on Satellites

Washington—Significance of electrical drag on satellite lifetime will be determined from Explorer VIII data now being analyzed, according to the National Aeronautics and Space Administration.

The Explorer VIII satellite, which made the first direct measurements of the ionosphere, was launched by a Juno II Nov. 3. It returned 500 bits of data during each second of its 54-day lifetime. NASA estimates it will take another six months to complete analysis from the ionospheric and micrometeoroid instruments. Ionospheric physics experiments previously had been done by radio propagation and with sounding rockets.

Robert Bordeau of NASA's Goddard Space Flight Center, ionospheric experiments project manager, summarized these preliminary findings based on analysis of about 15% of the data:

- **Ionized clouds which surround** satellites double the electrical size of the satellite. Size of the radar cross-section depends on cloud particle density.
- **Radio blackouts** apparently are caused by sunspot influence on the lower ionosphere, below 300 mi., since the upper ionosphere is relatively undisturbed during solar storms.
- **Oxygen is the main constituent** capable of being ionized in the lower part of the orbital path. The satellite has a 275-mi. perigee and 1,450-mi. apogee. Hydrogen predominates above 650 mi.
- **Electron temperatures** closely coincide with the value of the uncharged portion of ionospheric gas, which is 1,800K.

Satellite analysis of the ionized cloud determined that the leading portion consists of positive ions, with negative electrons in the wake.

Wesley M. Alexander, also of Goddard and project chief for micrometeoroid experiments, said Explorer VIII appears to be confirming the presence of small particles in the Leonid meteor stream.

Larger particles in the stream had been detected by telescopes and radar, and the Explorer VIII satellite recorded thousands of impingements of particles ranging in size from one-billionth to one hundred-billionth of a gram. Data is being correlated with findings from Vanguard III, which had an impact experiment with a maximum impact sensitivity of one-billionth of a gram. NASA hopes to relate micrometeoroid numbers and mass from the latter test.

NASA said the Explorer VIII experiment advanced the art of spacecraft technology by flight-testing a non-optical orientation device accurate to within 5 deg. The satellite contained several ion and electron traps which attracted charged particles and acted as an angle-of-attack meter. The signal produced was compared with the directional character of electronic currents off the surface of the satellite, and an error signal was provided.

Refinement of the device could reduce the accuracy error to 1 deg., NASA said.

Future ionospheric tests will be made by combining several of the experiments into a single instrument to be used on a time-sharing basis. Experimenters hope to fly the instruments piggyback on such payloads as passive communications satellites.

Germany to Order Super Frelons, S-58s

Paris—West German Defense Ministry plans orders for 150 Sud 3210 Super Frelon helicopters to meet its heavy turbine requirements plus 90 Sikorsky S-58s valued at about $27.7 million to fill the gap until the 3210s begin arriving in the mid-1960s.

The decision, closing out a competition that has been debated and re-debated in technical and political circles for almost a year, followed a series of high-level talks between government officials of the countries involved.

The Super Frelon, its future spurred by West German plans for a quantity order (AW May 20, p. 24), is scheduled to be produced in Europe on a multi-nation basis. The S-58s, whose order was agreed upon on a government-to-government level, will be produced entirely in the U. S. Sikorsky also will work closely with Sud on a technical-assistance and components-development level in the final design of the 3210, which is still in the mockup stage.

Although plans are still tentative, the present program calls for components production in Germany, and in Italy by Fiat, which already is building Sikorsky S-58 rotor sections under license and has a helicopter of its own in flight test, as well as by Sud. Most probable German firm to join the consortium is Bremen's Weser Flugzeugbau. An affiliate of United Aircraft Corp., Weser is now tooling to build the Sikorsky S-64 under license for the West German Defense Ministry.

Multi-nation production plans, which followed the German decision to order the Super Frelon over competing U. S. designs that could have been available substantially earlier, adheres to the spirit of a political agreement signed by the three nations in 1958 for mutual cooperation in the development and production of a helicopter family.

The Super Frelon was a late entry in German considerations for a heavy turbine helicopter to meet its military needs (AW Jan. 9, p. 37). Original contenders, which faded away after high-level Franco-German negotiations, were the U. S. Sikorsky S-61 and Boeing Vertol 107.

Canada to Build F-104s With Funds From U.S.

Washington—U. S. will furnish 66 McDonnell F-101B all weather interceptors to Canada under an agreement in which Canada will produce Lockheed F-104 fighters for European nations and will assume financing of 16 early warning radar stations.

Under an agreement following months of negotiations (AW Apr. 24, p. 27), the cost of manning, operating and maintaining the F-101Bs is to be borne by Canada, except for some initially furnished parts.

For the F-104 production program, the U. S. will contribute $150 million and Canada $50 million. These sums are subject to military budget requests and legislative approval in both countries. Deliveries are scheduled to begin in mid-1963.

These funds would provide for construction of about 150 aircraft. They reportedly will go to Greece and Turkey under the U. S. Mutual Defense Assistance Program.

The F-104 is similar to the F-104G being built by NATO countries.

The F-101B is limited to the air-to-air interceptor mission.

Sen. Stuart Symington (D.-Mo.) criticized the agreement to produce the F-104 in Canada as penalizing unemployed U. S. aircraft plant workers.

Five of the 16 radar stations will be U. S.-manned but otherwise Canadian supported. They are at Moisie and Saint Sylvestre, Quebec; Beaverbank and Sydney, Nova Scotia; and Gander, Newfoundland.

The stations which the Canadians will finance and operate are located at Baldy Hughes, Kamloops, Puntzi Mountain and Saskatoon Mountain, British Columbia; Beausejour, Manitoba; Armstrong, Lowther, Pagwa, Ramore and Sioux Lookout, Ontario; and Barrington, Nova Scotia.

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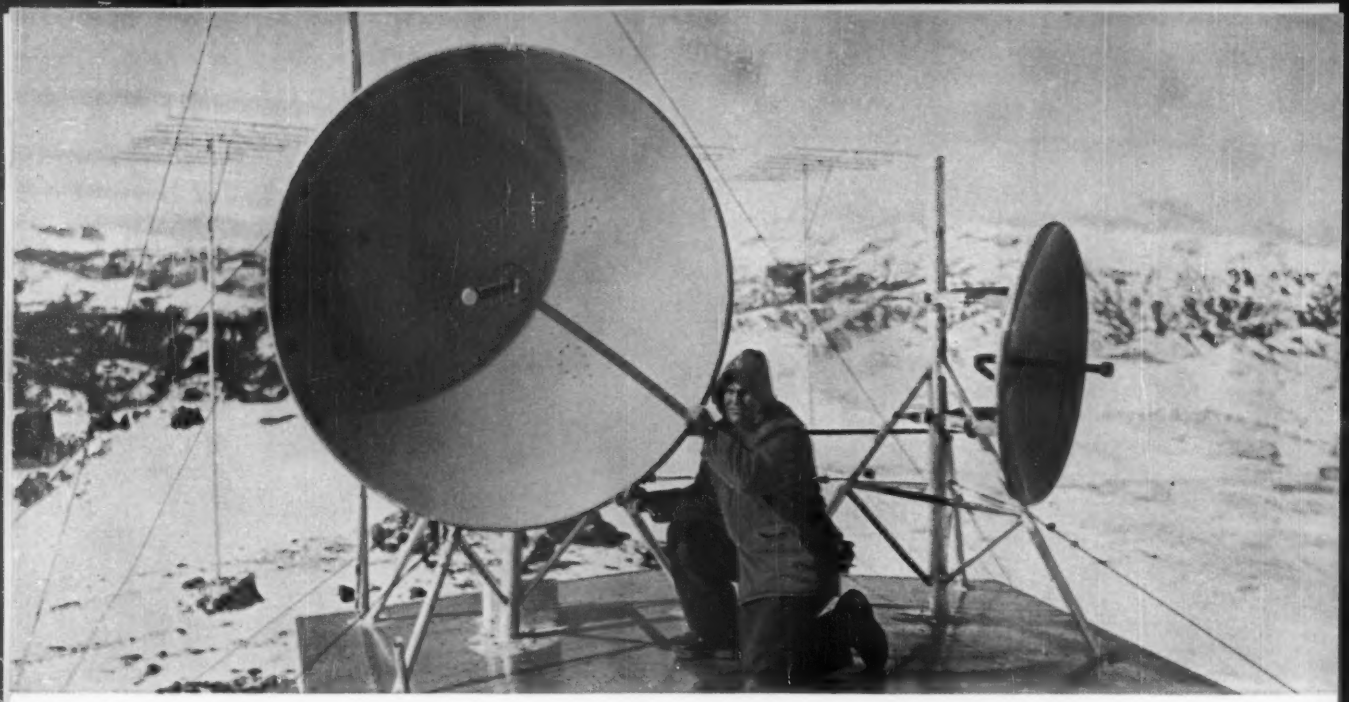

OVER... UNDER

From mountain-top television relays to new underground "survival" radio, Raytheon continues to pioneer in electronic communications.

High over the Rockies, Raytheon microwave relays beam TV programs to remote valley towns. This dependable equipment, almost inaccessible in winter, operates unattended day after day.

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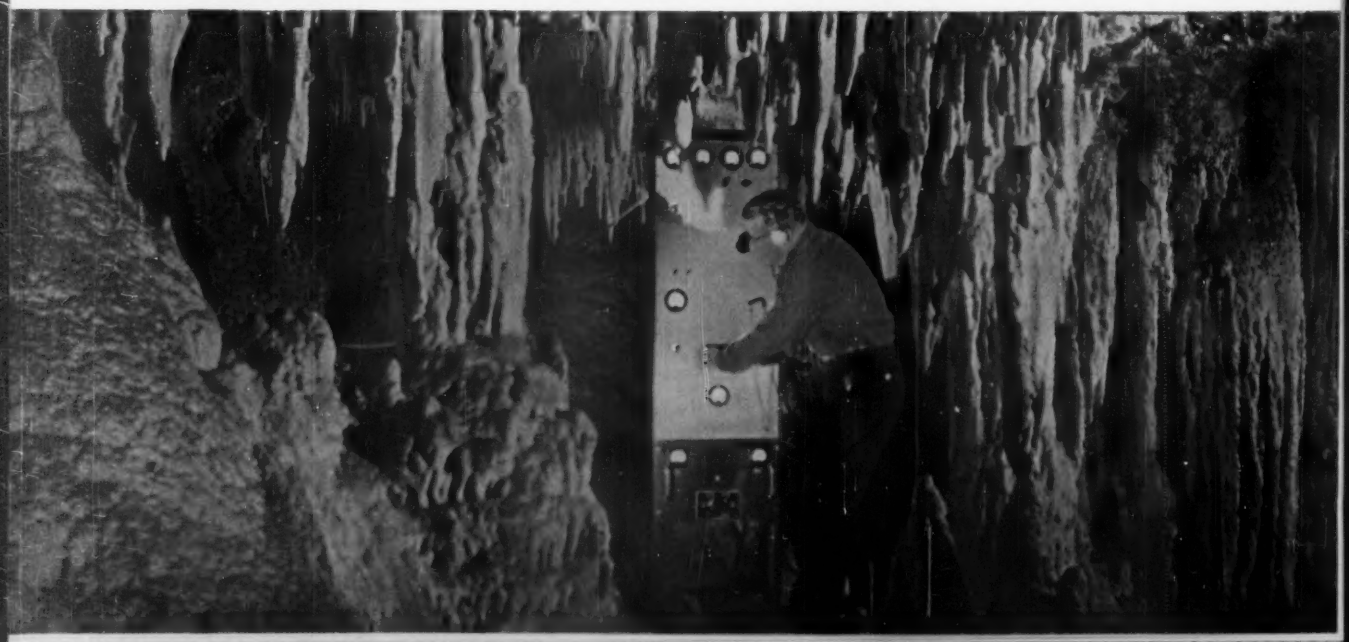


Holifield Urges U.S. Resume Nuclear Tests

Washington—Chairman Chet Holifield (D.-Calif.) of the Joint Atomic Energy Commission said last week that the U. S. should resume nuclear testing even if the move were condemned by the majority of the United Nations.

He said the U. S. "must assume the possibility or probability that the Soviets have been testing or will be shortly. In any event, we cannot continue to gamble our destiny when we base such a gamble on ignorance of our opponent's actions."

Rep. Holifield stressed, however, that the U. S. should continue negotiations with the Russians for a test ban, even while conducting nuclear tests. He suggested starting out by testing seismic detection devices underground, declaring they are "a necessary and important part of any test ban system."

The seismic experiments should be followed by tests of nuclear weapons and peaceful applications of nuclear energy under the Plowshare program, Rep. Holifield said. No tests should be made in the atmosphere, he added, but he did not oppose nuclear tests in space.

Rep. Holifield, who stressed he was speaking as a member rather than chairman of the Joint Atomic Energy Committee, said there were "certain configurations of nuclear warheads for missiles that should be tested." He said nuclear tests would advance concepts on the drawing boards "which could be as revolutionary as the H-bomb in 1949." They would also help develop lighter weight-to-yield ratios for missile warheads, anti-missile missiles, better small yield weapons and improved safety features.

Boeing Seeks 107 Licensee in Europe

Paris—Boeing-Vertol is negotiating license agreements with Dornier-Werke in Germany and with other firms in France and Italy for production rights to the Vertol 107 if sufficient European orders for the turbine-powered helicopter are obtained.

Despite the West German decision to purchase France's Sud 3210 Super Frelon to meet its major heavy turbine helicopter needs (see page 34), Vertol still has hopes of selling the 107 there and is pushing sales campaign in England, Belgium, Italy, Holland and other NATO countries.

As an initial step toward establishing a firm European base of operations, the company announced last week that it is forming a Swiss subsidiary to be designated Boeing-Vertol Europa S. A.

Immediate objective of the new firm will be to bolster 107 sales and service efforts in Europe. If European production is forthcoming, however, manufacturing rights will be granted to the Swiss subsidiary which, in turn, will pass them to Dornier and other licensees.

McNamara Orders Two Joint Fighter Projects

Washington—Defense Secretary Robert S. McNamara has modified his drive to develop a single tri-service tactical fighter, officially confirming the plan for at least two different aircraft and possibly three described by AVIATION WEEK early last month (May 8, p. 28).

McNamara has given the Air Force responsibility for developing a tactical fighter. USAF is to work with the Navy in developing specifications to ensure that the design will meet the needs of both services for interdiction, reconnaissance, air superiority and close support.

He also has assigned the Navy the task of developing a smaller aircraft for close support to meet the needs of the Army and the Marine Corps. Each service would have the opportunity to approve the original concept. This design could be a transonic version of the Douglas A4D, or a new aircraft.

There could also be an interim order for a close support aircraft, but the Army is reported to have withdrawn its original recommendation for the A4D.

Forcing the Air Force and the Navy to get together on the higher-performance aircraft renewed the controversy over size and configuration.

To have a low level speed capability of Mach 1.2 and a high-altitude speed over Mach 2 combined with a ferry range of 3,000 to 3,500 mi., the aircraft would have to weigh about 85,000 lb. This weight would be over the limit that the newer aircraft carriers can handle, and the dimensions would be too large for deck handling.

Stennis to Investigate Nation's Survivability

Washington—Senate Preparedness Investigating Subcommittee will take a new look next month at U.S. missile power, with special emphasis on the nation's ability to survive an initial attack.

Chairman John C. Stennis (D.-Miss.) told AVIATION WEEK he believes this probe into survivability will be the first ever made in a detailed fashion by a congressional committee.

"Our survivability prospects will be taken up with emphasis," Sen. Stennis said. The subcommittee will call in top military officers, scientists and defense industry officials to get a wide spectrum of opinion on survivability. Hearings will be in closed session.

Sen. Stennis said that another emphasis in the upcoming investigation will be on the current status of the missile force. "They talk a lot about capability," he said. "I want to know what we have now."

News Digest

Brig. Gen. Paul T. Preuss was named military adviser to Federal Aviation Administrator N. E. Halaby last week. Formerly FAA's assistant administrator for plans, he will take charge of Defense Department liaison and also retain responsibility for FAA's supersonic transport program. Deputy Administrator James T. Pyle was given the additional duty of acting administrator for plans.

North American Aviation will start construction in September on a 40,000-sq.-ft. missile and aircraft component assembly building in Princeton, W. Va. The new unit will be a feeder plant for the company's six divisions.

Custer Channel Wing Corp. has withdrawn its request for a hearing to determine whether Securities and Exchange Commission should vacate a Dec. 29, 1960 order temporarily suspending a Regulation A exemption from Securities Act registration with respect to a proposed stock offering. The suspension order therefore becomes permanent. SEC asserted in its suspension order that the company's offering circular was false and misleading regarding certain material facts.

Navy has developed a system for aerial retrieval of persons at sea or in remote land areas. A packet dropped to the person contains a special suit and a 500-ft. nylon cord. A balloon is inflated with helium which lifts the line into the air. The aircraft snags the elastic nylon line and the person gradually accelerates to the speed of the airplane and is then hoisted into the fuselage.

Alan L. Dean was appointed deputy administrator for administration of the Federal Aviation Agency last week (AW June 5, p. 43), filling one of the three deputy posts created by Administrator N. E. Halaby. Dean, who joined FAA in August, 1960, was formerly assistant administrator for management services.

Alexander G. Hardy, senior vice president and corporate secretary of National Airlines, resigned last week to join Automatic Canteen Corp. of America as assistant to the board chairman.

Foreign Lines Try to Prove U.S. Reneges

European carriers research old statements, records to show American reversal of bilateral principles.

By L. L. Doty

Paris—European flag carriers, alarmed over growing demands for traffic restrictions in certain North Atlantic markets, are launching individual campaigns designed to prove that U. S. interpretations of bilateral agreements are contrary to the original intent of Bermuda principles.

Several European-based carriers already have made extensive research studies into documents, minutes, congressional testimony and interpretative statements or speeches by the negotiators of the Bermuda pact to back their contention that the U. S. has completely reversed its concept of the Bermuda agreement. The obvious strategy is to show that the U. S. is not living up to its obligations under the terms of international agreements.

The expected result is to raise the issues to top diplomatic levels where they presumably will override any economic considerations at stake. To counteract these tactics, U. S. carriers are now charging that a number of foreign carriers are violating the original terms of their bilateral air transport agreements by offering excessive capacity and flight frequencies in primary markets and by carrying too much U. S. traffic in secondary or Fifth Freedom markets.

This fight, which has been waged continually for almost a decade, now promises to become especially bitter as competition intensifies with jet seat capacity steadily outstripping traffic growth on North Atlantic routes. Heart of the dispute is the degree to which this capacity should be controlled in order to provide a "fair and equal opportunity for the carriers of two . . . nations to operate any route between their respective territories covered by the agreement . . ."

Original Policy

Ironically, the U. S. strongly advocated a non-restrictionist policy during the Chicago Convention of 1944, while the majority of foreign nations sought some control of flight frequencies. The U. S. won over the opposition on most major issues, and it is this original policy of the U. S. that foreign carriers are reviving as evidence that the U. S. has switched its interpretation of the Bermuda principles.

For example, Britain fought vigorously for some control during negotiations at Bermuda and finally conceded to the Bermuda principles only because they represented a compromise between a restrictionist and non-restrictionist policy. However, in a letter from the British government to the U. S. secretary of state, protesting a Civil Aeronautics Board investigation to determine whether foreign air carrier permits should be revised to provide flight frequency control, this reasoning was developed:

"If foreign air carrier permits were amended in this manner, the Civil Aeronautics Board could unilaterally determine in advance such questions as the capacity, frequency and type of aircraft which would be provided by United Kingdom airlines on flights to and through United States territory. The conditions under which United Kingdom airlines may operate to and through the United States are those set out in the Bermuda Agreement which, as both parties have invariably agreed, does not give either party the right to determine unilaterally such questions as these."

Because the Bermuda Agreement is a compromise agreement, ambiguities are inevitable and permit a wide range of interpretation. U. S. carriers hold that the capacity clauses of the agreement specifically require restriction of frequencies or available seat miles when one party feels that an undue amount of seats is being offered over any one of the routes involved.

Foreign Arguments

Foreign carriers, however, believe that the U. S. is now promoting a new interpretation of the Bermuda principles which is contradictory to the basic philosophy developed by the original architects of these principles. Here is what one official of a European carrier told AVIATION WEEK:

Pan American vs. KLM

Washington—Pan American World Airways has charged KLM with violating its foreign air carrier permit and the U. S.-Netherlands bilateral agreement on scheduled flight operations to and from the U. S.

In a complaint to the Civil Aeronautics Board, Pan American said the violation arises "from KLM's offering air service in gross excess of the number of passengers and volume of cargo requiring transportation between Netherlands territory and the U. S. which is the agreed primary objective of the services."

Pan American also said "KLM compounds this violation by carrying amounts of traffic between the U. S. and third countries [Fifth Freedom traffic] far in excess of the 'secondary' or 'fill-up' volume permitted by the inter-governmental agreement." The airline said that KLM offers more service than can be justified "on the basis of traffic which the airlines . . . are to have a fair and equal opportunity to attract . . ."

KLM denied that it has violated or intended to violate any portion of the agreement. A Dutch delegation is here now negotiating with the State Department for a route to Los Angeles. Capacity restrictions are a key to the talks.

Bilateral Policy Warning

Washington—Civil Aeronautics Board Chairman Alan S. Boyd told Congress last week that the U. S. must "rethink" its policy on international air route exchanges and capacity, or face more difficult clashes with foreign governments in the future.

Boyd emphasized to a Senate appropriations subcommittee the need for more personnel to handle international activities, which are increasing in volume and complexity. In the past, he said, CAB has primarily been able to deal with separate bilateral issues, but now it finds that "blocs of countries are engaging in restrictive practices and acting in consort" to limit the traffic carried by U. S. carriers.

Noting that the airline industry last year had a net profit of only $8.8 million on revenues of $2.8 billion, the chairman said there is deep concern over the airlines' earnings and their declining share of the world market, since an increasing number of foreign carriers are planning to expand their share of the U. S. traffic market.

"To my mind, the proper interpretation of the Bermuda Agreement as conceived by the drafters and negotiators is too well documented and understood throughout the world to permit any new legal twist by a new generation of congressmen or aviation authorities."

To support such opinions, foreign flag carriers are drawing on statements of the "drafters and negotiators" to counteract the U.S. drive for restrictions. For example, one carrier has turned to a lecture delivered by George P. Baker, chief of the U.S. delegation at Bermuda, in 1947 at McGill University in which he said in part that "I can categorically say . . . that there would have been no Bermuda Agreement signed by the United States if that agreement were understood to approve or condone the inter-governmental allocation of capacity."

Another carrier refers to testimony given before a Senate commerce committee in 1946 by L. Welch Pogue, then CAB chairman and a delegate at Bermuda. This carrier extracts this statement by Pogue:

"The first point I want to mention about the unlimited schedules is that it is true that this [Bermuda] agreement provides no control over frequencies and that was basically our position . . ."

Charges by the U.S. that several European carriers are violating Fifth Freedom rights by carrying an excess volume of secondary traffic are flatly denied by these foreign flag carriers. Attempts by the U.S. to obtain an exchange of traffic statistics with these airlines so the actual volume of Fifth Freedom traffic can readily be determined have thus far failed.

Observers here feel that foreign flag carriers will counter the charges of Fifth Freedom violations by attempting to show that U.S. carriers are flying a substantial amount of Fifth Freedom traffic in other parts of the world, particularly in South America. They will also emphasize that there never has been a formula developed that defines what constitutes "excessive Fifth Freedom traffic."

Currently, restrictive measures have been taken against the U.S. by at least four South American countries and Mexico. India and Japan have also taken restrictive measures.

CAB Seeks Northeast Merger Partner

By Glenn Garrison

New York—Civil Aeronautics Board moved last week to help Northeast Airlines find a merger partner as a way out of the airline's financial problems, which included a net loss of $1.5 million for the first four months of 1961.

Ordering an investigation of Northeast's situation and prospects before deciding on renewal of the carrier's routes to the south, CAB included the question of whether Northeast should be merged with another airline if the renewal is granted. At the same time, CAB bureau counsel sent a letter to all domestic trunklines requesting estimates of traffic, revenues, schedules, operations and profits and losses in 1963 if they were to merge with Northeast.

In effect, the investigation is designed to determine whether a third carrier is needed on the northeast-to-Florida routes and, if so, if it is in the public interest to merge Northeast with another carrier.

Northeast's temporary authority to serve its routes south of New York expires next November. Timing of merger negotiations therefore is important, since Northeast presumably could make a better deal while the Florida route is still available, with the partner predicating the final merger on condition the route award is made permanent. Northeast recently has informally approached at least one carrier, Delta Air Lines.

Observers note another possibility—that of Howard Hughes seeking a stronger interest in Northeast. He has lent the airline $9½ million as part of Northeast's arrangements to lease Convair 880 aircraft.

Northeast recently refused to extend the deadline by which Trans World Airlines was to decide on a merger proposal by Northeast. James Austin, Northeast president, said this refusal was based to the fact that the TWA board never acted and changes within TWA made the immediate prospects of decision uncertain. Northeast was faced with day to day decisions such as hiring new officials and had to be free to act. But Northeast is still available to talk merger with TWA.

The bureau counsel questionnaire is unlikely to be answered by Eastern Air Lines, which opposes Northeast's renewal application. Eastern has no desire to discuss any proposition that involves a retention by a third carrier of Northeast's Florida routes.

Meanwhile, Northeast has been competing strongly in the Florida markets with its new fleet of 880s. With more jet schedules from the northeast to Florida than either of its two competitors, Northeast's winter season traffic in and out of Florida was up 22.8% for the December through April period for a total of 188,820 passengers.

According to Austin, Northeast's share of the Florida market was about 25% by the end of the first quarter of 1961, up from 13% at the end of 1960.

Among the reasons for the disappointing financial results this year, Austin told AVIATION WEEK, were "deplorable" operating conditions from a weather standpoint, and shakedown problems in integrating the fleet of jets.

Actually, Northeast enjoyed only about six weeks of the peak Florida season with a full fleet of jets. The first airplane went into service Dec. 15, and the entire fleet of six was not delivered and in service until March. It had been hoped that all aircraft would be available for the winter season, but managing to have the airplanes released, financed and delivered caused a delay (AW Nov. 28, p. 39).

The final, subsequent arrangement was the formation of a special corporation, Nelco, Inc., to purchase from General Dynamics Corp. the seven-year lease for the six 880s, under which Northeast started operating the airplanes. Nelco is owned jointly by Aviation Financial Services, Inc., an affiliate of the New York investment firm of Smith, Barney & Co., and Equilease Corp. of New York, largely owned by the Electric Autolite Co. Autolite recently acquired Hiller Aircraft Corp. In case of default, however, General Dynamics would be called on for payment.

Weather, Austin said, even minimized the benefits that might normally have accrued to Northeast due to strikes at Eastern and National. With the extra traffic available for the asking, operation was shut down by weather a good bit of the time.

Austin said his airline was able to begin jet service last December only because he is "a speculator at heart," because a number of things had to be done in advance, before the jet financing had been firmed up. For example, considerable funds had to be channeled into training and in vendor items with lead times of six to eight months if jet introduction was not to be further delayed. After the first jets were acquired and service began, one problem which hampered operations was the need for proper positioning of spare parts at various stations. Experience was required to handle this suitably.

The airline's daily utilization with its 880s now is averaging 8½-9 hr., Austin said. The figure would be higher but for the fact that many 880 trips fly a short segment before a long one—for example, Boston to New York and then to Miami.

In March, after the sixth 880 went

into Florida service, Northeast said it was operating 47% of the nonstop jet schedules between the northeast and Florida. Eastern's share was 27.5% and National's was 25.5%.

Of the current nonstop jet schedules, Northeast's share is 48% as of June 11, according to the airline.

Northeast's average weekly capacity in and out of Florida during the past winter season was 12,747 seats, up 10.8% from the previous season. This month, the summer schedules call for 17,514 seats a week, up from 8,197 seats a week last June. The percentage of jet seats this June is 77.5% of the total, the remainder being offered in Douglas DC-6B equipment.

Regarding the future of the Florida market, which over-all was off this winter and has shown signs for some time of slowing down, Austin believes there is plenty of market if all carriers will schedule realistically. East Coast to Florida, the Northeast executive said, is still the number one volume market of the world and could support the present carriers even if there were some permanent drop in volume.

Austin predicts a good summer for Northeast in Florida, with new low fares and package vacations, public responsiveness to the airline's jet services, and increasing identity of Northeast in the market. The question of establishing its identity was a major problem for the airline, and Austin said "we are still fighting for it" although considerable progress has been made.

Northeast has forecast it will carry 400,000 passengers in the Florida market this year, up from 281,854 in 1960. In its first year of operation in the market, 1957, the total was 97,113.

The Florida market is far and away Northeast's most important, involving the bulk of passenger miles flown. But another important market, which the airline acquired at the time of its Florida route award, is its Boston-New York, Boston-Philadelphia, Boston-Washington and New York-Washington segments, served by Vickers Viscount turboprops.

Northeast flies hourly on-the-hour schedules in this "commuter" market and, according to Austin, is now handling about 30% of the New York-Washington traffic, 35% New York-Boston, 70% Boston-Washington and 65% Boston-Philadelphia. Over-all load factor is averaging between 65% and 75%. Last year's traffic on these routes totaled 646,757 passengers, up from 453,929 in 1959.

But Northeast is in for some tough competition in this market. American plans to come in heavily this month with Lockheed Electra turboprop schedules which will almost entirely replace piston schedules. American also is adding a premium service for meal-time flights, a de luxe offering at slightly above first class fares. With Eastern operating its low-fare "air shuttle" service and Northeast sticking with the straight first class, there will be competition among classes of service as well as airlines.

But Austin predicts Northeast will hold its own in this market. The Viscount, he contends, is the best airplane for the commuter-type service. Northeast plans to keep its schedule pattern as is.

Regarding the "air shuttle" recently inaugurated by Eastern between Boston and New York and between New York and Washington, Austin said he doesn't fear it will divert traffic significantly from Northeast. The sophisticated commuter type of passenger who uses the regular services on these routes will continue to do so, Austin believes (AW May 8, p. 40).

Northeast's third market—which was its only area until the route awards thrust it into the big leagues—is within New England. This market is now being served with DC-6Bs released from Florida service and some DC-3s. It has always lost money for Northeast, but prospects are better now as the four-engine equipment boosts seat capacity and provides more dependable service. A major goal in this service is to consolidate points served so that areas with very little traffic can use nearby larger terminals which are still convenient, but offer better service with the bigger equipment.

In applying for renewal of its southern routes on a permanent basis, Austin told the Civil Aeronautics Board in March that the airline had invested more than $90 million since 1956 to assure the success of its expanded operations. Northeast had successfully weathered the "burdensome transitional years," Austin said, and is in a position to operate profitably in the future.

Among the factors operating against Northeast during the first couple of years it was attempting to establish itself in the Florida market, Austin cited delays in obtaining certification of Bristol Britannia turboprops, which led to cancellation of the purchase contract; "particularly intense competition" from existing carriers including a program ". . . accurately described by its major competitor as 'positive offensive action of smothering the competition with schedules'"; business recession; unusually bad weather, and the Pan American-National lease which put National first with jet aircraft in the market.

Notwithstanding these unexpected adverse factors in the early years, Austin said, Northeast has effectively penetrated the Florida market.

Austin told AVIATION WEEK that load factors in the Florida market for the first quarter of 1961 averaged 59.3% for all aircraft, up from 49.3% in the first quarter of 1960.

Hearings Required

Washington—Supreme Court ruled last week that the Civil Aeronautics Board must provide an airline with notice and hearing in any case concerning reconsideration of a route authorization before a certificate can be awarded.

Emphasizing that CAB is not barred from reconsidering its initial decision, the court said the Board has many statutory procedures in handling reconsideration cases which make it unnecessary to "improvise on the powers granted by Congress in order to preserve administrative flexibility." In addition to notice and hearing, the court said, these procedures include postponement of effective date of a route certificate or the issuance of a temporary certificate.

The court's decision was based on restrictions placed on routes awarded Delta Air Lines in the Great Lakes-Southeast Service Case after the final decision. The Board amended Delta's certificate on May 7, 1959, to impose restrictions on routes that had become effective Dec. 5, 1958.

FAA Project to Test Sonic Boom Effects

Washington—Federal Aviation Agency has initiated a six-month flight test program to determine what effect the sonic boom problem will have on future supersonic transport operations.

Under a joint agreement with the Air Force and the National Aeronautics and Space Administration, a series of flight tests are to get under way this summer with USAF B-58, F-104, F-105 and F-106 supersonic aircraft.

NASA has conducted supersonic boom tests in the past with B-58 and F-104 aircraft at Langley Field, Va., and Nellis AFB, Nev., and has scheduled further B-58 test flights simulating commercial use at Edwards AFB, Calif., this year (AW Nov. 14, p. 54). NASA's primary role in the joint program will be to provide the necessary instrumentation for pressure measurements, communications and tracking equipment and data analysis.

Scope of the program will include sonic boom measurements at high and low altitudes, with climb and descent maneuvers. Wind tunnel tests will also be conducted to determine how design of supersonic aircraft might minimize the boom intensity.

Community surveys will also be conducted to judge public reaction to the various types of boom.

New Holding Patterns Designed For Major Air Terminal Areas

By David H. Hoffman

Washington—Federal Aviation Agency will erase the "racetrack" boundaries of all holding patterns in the air traffic control system and substitute geometrically designed blocks of airspace that expand with altitude.

The new holding pattern concept, which will be implemented not later than Jan. 1, is an FAA attempt to conserve the rapidly dwindling airspace surrounding major U. S. terminals.

Shaped somewhat like irregular eggs, the plotted patterns take into consideration the flying characteristics of aircraft types that hold at various altitudes during typical bad weather conditions. New speed limits are set accordingly.

FAA's Bureau of Air Traffic Management has developed 31 of the new patterns. Identically proportioned, they range in size from a width of 6.7 naut. mi. and a length of 11.6 naut. mi. to a width of 57.0 naut. mi. and a length of 84.9 naut. mi.

Generally, three factors govern which pattern will be prescribed for a particular holding fix—the speed of the aircraft assigned to the pattern, the distance from the fix to the navigational facility that defines it and the altitudes used for holding purposes above the fix. As each factor increases, so does the size of the pattern.

Under the present holding system, which involves perfectly elliptical patterns, pilots are expected to maneuver so as to remain within an airspace of precisely defined dimensions. They deal with only two pattern sizes, the one minute pattern and the two minute pattern—minutes refer to how long the outbound heading should be maintained.

According to David D. Thomas, ATM's director, "all significant factors which can affect the aircraft flight path while entering and maneuvering within the pattern area have been considered; therefore, the pilot need only adhere to the standardized operating procedures and limitations for this type aircraft in order to be assured of containment within protected airspace" under the new system.

Specifically, the "significant factors" cited by Thomas include assumptions that the average pilot will execute a holding pattern turn with 25 deg. of effecting bank, that he may fly an extra 6 sec. overshooting his entry turn, that navigational equipment may be inaccurate by as much as plus or minus 5 deg., that winds may reach 50 kt. at 4,000 ft. and increase 3 kt. with every 2,000 ft. of altitude increment to a maximum of 120 kt. and that pattern airspace can be reduced if entry from an optimum direction is guaranteed. The patterns, moreover, are predicated on these maximum airspeeds:

- **Propeller-driven** aircraft below 14,000 ft., 170 kt. indicated; above 14,000 ft., 175 kt.
- **Civil turbojets** below 6,000 ft., 200 kt. indicated; from 6,000 through 14,000 ft., 210 kt.; above 14,000 ft., 230 kt.
- **Military turbojets** with subsonic capability, 230 kt.; with supersonic capability, 265 kt. except for the Republic F-105 and Convair B-58, which must observe 310-kt. speed limits.

Until the new system is implemented, civil turbojets still must not exceed 180 kt. in holding patterns.

After Jan. 1, 1962—or earlier if FAA centers can plot the new patterns in less time—pilots will enter almost all patterns either along the holding course or its reciprocal or at a "very small" angle thereto. Radar service, wherever available, will be furnished before the aircraft reaches the assigned holding fix. Pilots will be expected to slow their aircraft to maximum pattern speeds 3 min. prior to their estimated time of arrival over the holding fix.

To aid air traffic control officials in plotting the patterns on local area maps, FAA plans to mass produce a series of 31 templates for field distribution. Each numbered template traces the boundary of one pattern on a 1 to 500,000 scale map. Associated tables tell controllers which template to select for particular distance-airspeed-altitude combinations.

Helicopter Lines Face Pressure on Subsidy

Washington—Helicopter airlines are facing strong House and Senate pressure to reduce their mounting subsidy bill, and helicopter operations appear headed for closer congressional scrutiny in the future.

CAB asked a Senate appropriations subcommittee last week to support its $90.7-million budget and restore $6.9 million cut by the House from subsidy requests for local service airlines and helicopter operations. In particular, the Board opposed a House recommendation which would limit subsidy to $5 million for the three helicopter airlines in Fiscal 1962 and would bar such subsidy the following year.

Terming the House stand "dogmatic" and "arbitrary," CAB Chairman Alan S. Boyd warned the subcommittee that any significant reduction in subsidy for the helicopter service would "put them out of business."

Complicating the issue of helicopter subsidy are applications for CAB-guaranteed loans totaling more than $29 million for new turbine-powered helicopters on order by Los Angeles Airways, Chicago Helicopter Airways and New York Airways. The Board would guarantee $26 million of this sum, Boyd said, and has approved in principle the application of New York Airways.

Replying to criticism on the mounting subsidy needs of the three carriers and the fear expressed by one subcommittee member that applications for new service might go on "ad infinitum," Boyd said it is hoped that the experience of the three carriers with new equipment might result in lower operational costs, which could be achieved by any new operators. On the guaranteed loan, he reminded the subcommittee that CAB had opposed the addition of helicopter operators for eligibility, but was overruled by Congress.

Should the House cut in Fiscal 1962 subsidy be upheld by the Senate, the carriers could not get their full requests from CAB, but under the Federal Aviation Act they would have a valid claim against the government, he said. Boyd estimated that helicopter subsidy needs would "peak out" at $8 million by 1963 and decline to $5 million by 1966.

Industry reaction to the House cut ranged from one comment that the three helicopter airways could "live easily" on the $5-million limitation to another that the cut would have a "serious" effect on operations. Both observers interpreted the House findings as an attempt to keep CAB from certificating any more subsidized helicopter airlines until there is more experience with the coming generation of transport helicopters.

Jet Fuel Tax Studied

Washington—House has voted to extend the 10% transportation tax, but no action has been taken on the proposed jet fuel tax pending the results of a Treasury Department study of new ways to recover federal airways costs.

Chairman Wilbur Mills (D.-Ark.) of the House Ways and Means Committee said "I have not made up my mind that the jet fuel tax is a proper way to tax airplanes." He said he first wants to see the results of the Treasury Department study. Rep. Mills added that leaders of the transportation industry had approached him on a proposal to reduce the transportation tax on the airlines from 10 to 5% and to impose a 1% tax on airfreight. The travel tax on buses and railroads would have been repealed. The committee rejected the proposal.

WEST WING (left) of the Orly terminal building has been completed and provides parking space for 24 aircraft. Buildings to the right of the terminal will be razed and an east wing will be constructed to increase aircraft parking areas to a total of 40.

Orly Airport Automates Procedures for

By L. L. Doty

Paris—Paris Airport Authority's $24-million terminal at Orly Airport, now in its fourth month of operation, stands out as a test case as to how self-sufficient passengers can be in following checkin-in, immigration and customs procedures.

The terminal was designed to eliminate the "herding routine" in handling passengers and, thereby abandons the established European practice of grouping passengers under the guidance of an agent or hostess for each step they must take toward boarding an airplane in international travel.

Already the "Orly system," as the new streamlined passenger-handling procedure has been labeled here, promises to be one of the first fully practical methods of conducting the flow of both inbound and outbound passengers efficiently and easily. There has been criticism leveled at the system from both passengers and airline personnel but, generally, dissatisfaction stems from minor details of the operation and not from the basic over-all system.

Under the Orly system, a passenger offers his baggage for customs inspection at the airline ticket counter at the same time he checks in for a flight. He then follows direction signs to the customs border control, where there are 17 immigration clearance posts, and then proceeds on his own to the departure gate to board his aircraft.

International flights can be boarded as early as one hour before departure. If the passenger has any doubt as to the proper boarding location, he may pick up a telephone installed at each gate and reassure himself by querying the flight control information center. If he chooses to wait in the terminal for flight departure, he may stop at the lounge containing shops, a nursery, baths and dressing rooms, a chapel for all denominations, bars, a restaurant serving 300 persons, and 16 modern hotel rooms.

Facilities Analyzed

Paris Airport Authority spent three years studying and analyzing airport facilities throughout the world in on-the-spot surveys. Airlines were consulted frequently, although not as often as many would have liked, in the planning and development of the Orly system. As a result, most of the airport's tenants are satisfied with the technical features and functional make-up of the new terminal. In contrast, the terminal has not received the volume of criticism that has been directed at New York's International Airport or Rome's Leonardo da Vinci terminal, two of the most modern international facilities.

Major problem has been the passenger himself, who is experiencing but, in many cases, not appreciating a new-found independence. Airlines here are learning that many travelers seek, rather than avoid, the verbal instructions of uniformed personnel and that some, without the comfort of this guidance, often get lost despite the simplicity of the Orly layout.

Airport officials here, however, reason that passengers will gradually become as familiar with international airport routine as they are with railroad depot routine as the popularity of air travel expands. They also point out that individualized attention will become increasingly impractical and inefficient as traffic volume grows.

Passenger traffic through Paris is expected to reach 6 million in 1965, 12 million by 1975.

Many passengers have complained of the long distances they are required to walk between airplane and airport entrance or exit. However, it is an inescapable fact that heavy traffic demands large floor areas which leaves no alternative but to walk. Orly's walking distances have been eased by a large number of escalators and direct or straight passenger routes from one point to another. Baggage counters are located only a few paces from entry and exit points.

Much of the convenience of the Orly terminal rests on its electronic system

EXPRESSWAYS provide fast accessibility from Paris to new Orly Airport. View shows main entrance to the new terminal building with National Highway No. 7 passing directly under the terminal and the runways of the airport.

Passengers

which operates facilities such as the escalators, information boards, public address system and clocks. When this system fails, as it reportedly often has, the passenger is bogged down in a welter of confusion.

Station Managers

Airline station managers are slightly concerned with the time consumed by the lengthy walking distances. One station manager told AVIATION WEEK that if a passenger had not checked-in at least 14 min. before plane departure time, he could not possibly make the flight.

All downtown checking-in has been eliminated in Paris. The traditional Invalides downtown air terminal is serving as an information and travel bureau as well as a bus station for transportation to Orly and Le Bourget, Paris' second major airport.

Orly's new terminal can be expanded to accommodate 8 million passengers per year. Thus, Paris airport officials will continue to operate Le Bourget, which has a capacity of 4 million passengers annually, to handle the surplus from Orly Airport.

Orly will be the main international airport for Paris and will continue to handle a large part of inter-European traffic. Le Bourget is the terminus for European carriers, including Aeroflot, and is a focal point for a large network of routes that reach into Africa.

Orly has become a major tourist attraction in Paris and is now playing host to as many as 25,000-30,000 sightseers a weekend. Originally, the hordes of tourists blocked the flow of air travelers adding to the confusion of a new passenger-handling system. However, specific turnstiles for tourists have been installed and passenger facilities have been sealed off from the sightseer's areas so there is a demarcation between the two groups.

Paris Airport Authority, which is responsible to the French Ministry of Public Works and Transportation and is supervised by the Ministry of Finance, is governed by a board of directors consisting of 24 members. The Authority operates both Orly and Le Bourget.

The Authority is not responsible for air traffic control, which is managed by a separate government agency, but it provides and maintains the facilities and installations necessary for this service. The Authority also builds and maintains runways, approaches, aprons, hangars and maintenance facilities. Maintenance of landing aids, refueling and loading systems, warehouses, parking lots, road systems and the terminal itself—which employs 10,000 persons—is the responsibility of the Paris Airport Authority.

In planning the terminal building, the authority rejected the separate building system, such as that now in use at Idlewild, as "uneconomical and inconvenient."

All facilities—including airline and government technical and administrative offices, air traffic control and weather bureau offices, employe lunchrooms and locker rooms—have been concentrated in the new terminal. However, all such facilities have been subordinated to the areas designed for passenger service and safety.

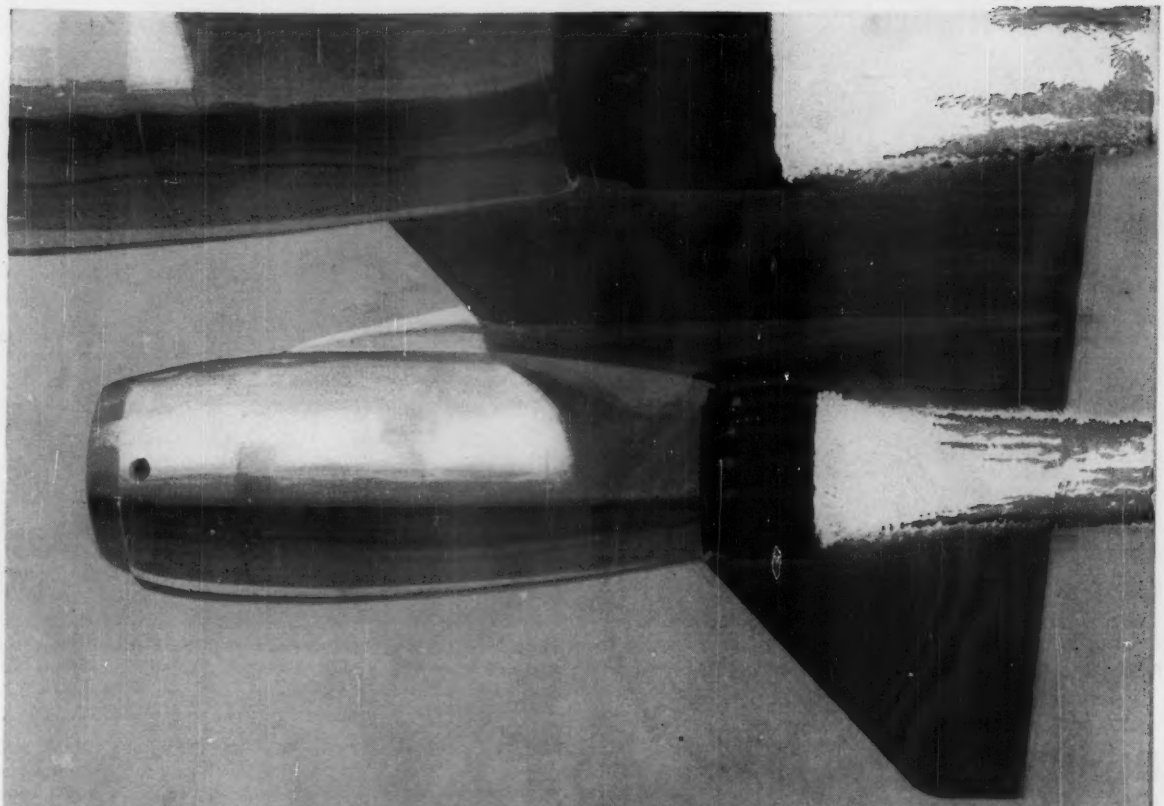
Control tower, which is now located on the eastern edge of the field, will eventually be rebuilt on top of the terminal which contains nine stories and covers 1 million sq. ft. of floor space. It is the largest building that has been constructed in France since Louis XIV erected the Invalides. Terminal construction began in 1957.

Ticket Counters

Individual airline ticket counters—45 carriers including four French airlines serve Paris—are located in the main hall, which is 620 ft. in length, off the main entrance to the terminal on the first floor.

The central lounge, 560 ft. in length, is located on the first floor. Shops, bars and a post office are located in this main waiting room equipped with an adequate number of seats and tables. The customs-free lounge occupies the second floor.

The third floor contains a bar, snack bar, coffee shop, open-air terrace restaurant for 200 diners, the formal "Le Tourne-Broche" restaurant and a dining area with a dance floor for special parties. Two conference rooms and a theater accommodating 350



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people, which has not yet been leased by a concessionaire, are also available. In addition to the 16 rooms in the customs-free area, 40 hotel rooms are under construction on the fourth floor on the French side of the customs frontier.

Several major airlines have leased space within the terminal to provide privacy for their "very important passengers." Although none of these special rooms as yet has been completely equipped and decorated, it is difficult to see how the relatively small spaces allotted the carriers for this purpose can match public facilities for any need.

Paris Airport Authority has set aside three special rooms for handling government dignitaries. In addition, a special reception room, furnished with antique French furniture and tapestries, has been reserved for high-ranking officials. A private terrace off this room permits military reviews without disrupting the normal functions of the airport.

Baggage Movement

All baggage is moved to and from loading trucks on convevor belts. The terminal is equipped with 11 passenger elevators, 21 escalators, six freight elevators and a medical elevator.

At the present time, there are 24 aircraft parking spots. Parking areas for aircraft are designated by a central control section which also operates the luminous signs that direct passengers to their flights. It operates the arrival and departure boards and handles all announcements on the public address system which are confined to three announcements for each flight.

A control and command section of the airport is operated on the main floor of the terminal through the use of an electronic panel that represents each of the nine floors of the building in small scale. White markers indicate operating order of all lighting; green markers record operation of heating, ventilation and electronic systems; 198 indicators glow red if one of the building's 4,000 fire-indicators shows a rise in temperature.

Ventilation System

The building's ventilation system produces 13 million sq. ft. of air per hour through 11 mi. of ducting. A slight degree of pressurization within the building is used to keep outside air from entering the terminal through doorways.

In terms of passenger traffic, Paris now ranks eighth in the world. Traffic handled by French carriers represents about 25% of all Paris airport traffic. North American carriers account for 10% of the total. Greatest portion of Paris traffic is that moved between France and other European countries.

MAIN TERMINAL building at Orly Airport is about 600-ft. long and 230-ft. deep. West wing is completed; east wing will be finished next year. Wings are each 820 ft. in length. Nine-story building contains about one million sq. ft. of floorspace.

ALL FLIGHT information about aircraft at the plane-loading area of west wing is given on overhead panel. Telephone nearby connects passengers with flight information center.

TRANSIT AREA at Orly Airport. This area also has a tax-free shop, a restaurant, 16-room hotel, nursery and chapel.

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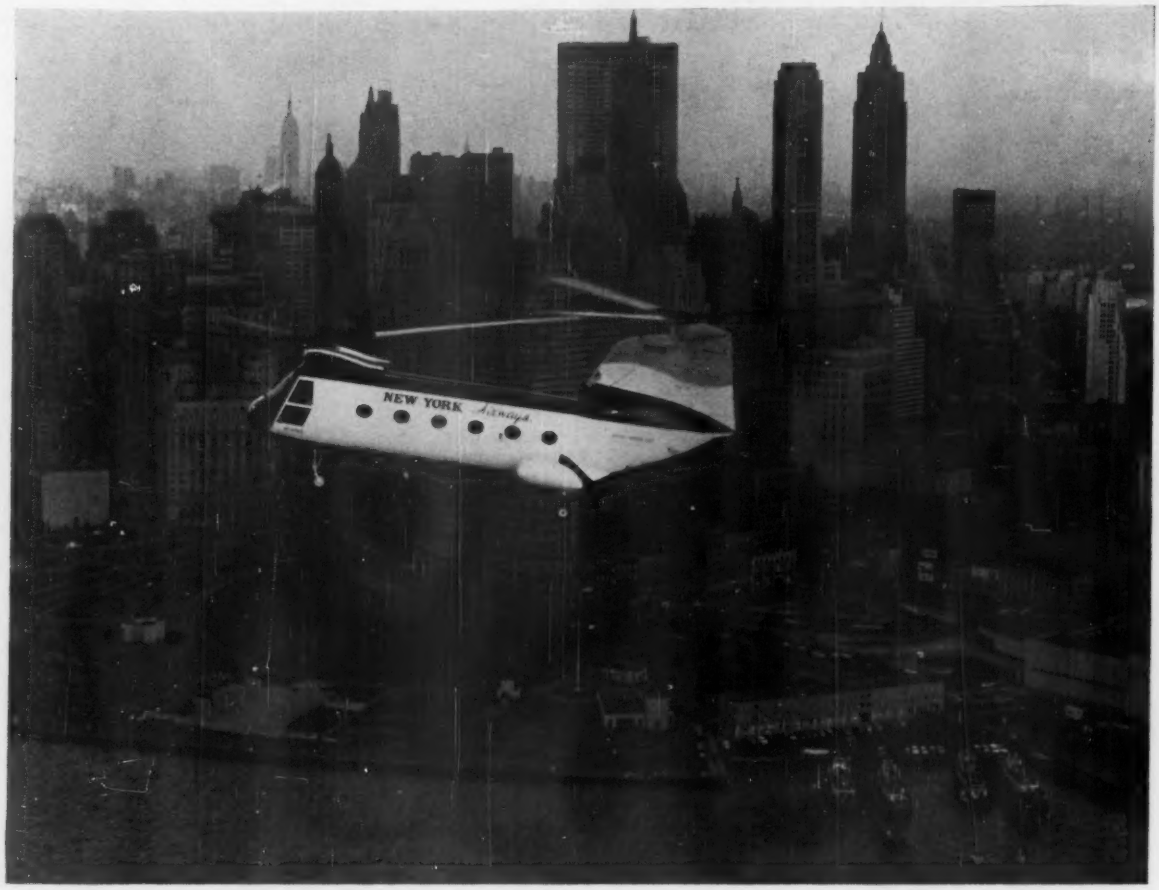
French Transports Perform at Paris

Max Holste Super Broussard prototype (above) flys over Le Bourget Airport at the 24th Paris International Air Show. Sud Aviation-General Electric Caravelle transport (center photo) lands with clamshell thrust reversers extended behind its CJ805 aft-fan engines. Breguet 940 STOL transport (bottom photo), designed as a testbed for the Breguet 941 unpressurized military transport and the pressurized 942 passenger-cargo carrier, has accumulated 300 flight hours since first flight in 1958.



TWIN-TURBINE HELICOPTER. The Boeing-Vertol 107—fastest, smoothest-riding commercial helicopter now flying—goes into service with New York Airways this summer. It seats 25 passengers in comfort, cruises at 155 mph and operates with equal ease from land or water. The 107, first twin-turbine helicopter certified by the FAA for commercial service, has also been ordered for service in Japan. Military versions have been ordered by U.S. Navy, Swedish Navy and Air Force, and Royal Canadian Air Force.

Capability has many faces at Boeing

JET-AGE FIRE FIGHTER. Boeing gas turbine engines power fire trucks in San Francisco and Seattle. These 330 hp engines weigh only 335 pounds, propel 15-ton trucks from standing start to 25 mph in 9 seconds.

SPACE GLIDER. Drawing of U.S. Air Force's Dyna-Soar manned space glider, designed to rocket into space, then re-enter the earth's atmosphere for conventional pilot-controlled landing. Boeing is system contractor for Dyna-Soar.

OXYGEN FOR SPACE. Boeing space medicine research includes growth of green algae for conversion of carbon dioxide into oxygen in space vehicles. In test, a Boeing researcher has lived 56 hours on algae-produced oxygen in sealed space chamber, proving potential of carbon dioxide-algae-oxygen cycle.

BOEING

Standard TBO System Proposed For Used Transport Transfers

Washington—Federal Aviation Agency has offered U. S. airlines interested in buying used equipment a standard system for rapidly stretching their authorized overhaul times to industry averages.

The new proposal is designed to ease the economic burden that results when a carrier modernizing its fleet with used aircraft is forced by the present system to roll back times between overhaul (TBO) by several hundred to several thousand hours. Carrier comment is due not later than July 15.

An outgrowth of the recent conference in Indianapolis between FAA and small airline representatives (AW Apr. 17, p. 51), the system considers the relative complexity of different transport types and expresses this relationship as a percentage on a scale.

Although the percentages in the FAA's proposal are tentative and subject to modification on the basis of industry comment, 100% might represent the Boeing 707's "complexity scale" from a maintenance standpoint. The Douglas DC-7, then, would be rated at 90% of 707 maintenance complexity, the DC-6 at 85%, the Convair 340 at 80%, the DC-4 at 70% and the DC-3 and Curtiss C-46 at 65%.

But FAA realizes these percentages are meaningless unless they can be applied to standard TBOs assigned to commonly traded aircraft and engines. As a result, FAA's Bureau of Flight Standards is developing "industry average specifications" or TBOs for C-46 and DC-6 series aircraft. Comparable specifications governing Convair 240-340 and Lockheed Constellation TBOs will follow after the agency has enlisted the aid of airline maintenance officials in its program.

Practical Application

To illustrate the system's practical application, a C-46 operator interested in acquiring Convair 340s as replacement transports would know in advance what TBOs it could expect FAA to authorize. The C-46 operator could determine this by subtracting the C-46's complexity rating from the comparable 340 figure to obtain a percentage difference—15% according to present planning.

The purchasing airline would learn its starting Convair overhaul time by subtracting 15% from the Convair 340 industry average TBO.

In its proposal, FAA explores the question of how long it will take a new operator to acquire the additional knowledge necessary to do an adequate job of maintenance using maintenance and overhaul times that equal the industry average. The agency believes the answer is keyed to how much maintenance know-how the new operator already has when it buys the more complex aircraft.

The operator which has half the knowledge necessary to maintain a particular transport at the industry standard presumably will acquire the other half twice as fast as another operator with no maintenance background, FAA's philosophy indicates.

To furnish the highly subjective judgments on which this approach is founded, a Maintenance Review Board (MRB) somewhat similar to the boards that now fix initial TBOs for new airframes and engines would be established. The "used equipment" MRB would include the field inspector assigned to the operator making a purchase, one maintenance specialist from the FAA's appropriate regional office and one permanent chairman from the agency's Washington headquarters.

Setting New TBO

Under the proposal, when an airline advises FAA of a planned purchase, the MRB will meet with the airline's maintenance officials. Together, the two groups will determine the relative complexity of the airline's old and new equipment. The value of the operator's maintenance background will be analyzed and starting TBOs assigned on the basis of its qualitative value.

"It is expected that this (starting overhaul time) will always fall between 75% and 90% of the industry average," according to George H. Weitz, acting chief of the Bureau of Flight Standard's maintenance division.

Next step in the process is an MRB determination of how much time must elapse before the new operator's TBOs, on engines and all time-controlled components, can be adjusted upward to industry averages. In making this determination, FAA wants the MRB to consider:

- **"Maintenance density"** in the airline's shops. Thus the operator with, say, a five aircraft fleet and a continuous or block overhaul system can be expected to acquire technical expertness far faster than another operator with one transport and an "all at once" overhaul system.
- **Formal training programs** instituted by the new operator. FAA now feels that broad based training programs for foreman and mechanics could shorten the time required to reach industry average TBOs by as much as 50%. Before industry average TBOs would be awarded, however, the MRB would reconvene and examine the operator's reliability record since it bought the new equipment.

This examination would be based largely on the MRB's judgment guided by industry average failure and feather rates for the new powerplants and daily mechanical reports on the remainder of the aircraft.

KLM Electra Crashes On Landing at Cairo

Amsterdam—KLM Royal Dutch Airlines last week was investigating two accidents that struck the carrier in succession over a two-week period. The accidents caused fatalities, claiming a total of 82 lives. KLM previously had gone almost three years without a passenger fatality.

In the latest accident a KLM Lockheed Electra turboprop transport struck a sand dune on June 12 during a low turn before final approach to Cairo Airport after a flight from Amsterdam en route to Malaya. Twenty of the 36 persons aboard were killed.

An airline spokesman said the aircraft, its landing gear down, had been cleared for final approach and was in the midst of a right turn when one of the wheels plowed into a small sand dune. Out of control, it then smashed into another dune about 200 yards away, with the fuselage breaking in half. The tail unit also caught fire.

The Electra involved had been delivered to the Dutch carrier early this year. All structural modifications ordered by the Federal Aviation Agency after two Electras broke up in midair over the U. S. in late 1959 and early 1960 had been incorporated on the production line.

On May 30 a KLM Douglas DC-8 jet transport on lease to Viasa, Venezuelan international airline, crashed into the ocean 1½ mi. off the Portugese coast shortly after takeoff on a scheduled flight from Lisbon to Caracas. All 62 persons aboard were killed. The aircraft had a Dutch flight crew aboard.

The DC-8 fuselage, described by a KLM spokesman as apparently "in relatively good condition," was discovered by divers in shallow water. Attempts to raise it to determine the crash cause were scheduled to begin late last week.

The pilot's routine post-takeoff radio transmission to the Lisbon tower ended abruptly in mid-sentence, from electronic failure or for other reasons, and there were no immediate indications as to the probable cause of the crash.

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AIRLINE OBSERVER

► U.S. airline interest in the Sud Aviation medium-range Caravelle turbojet transport is on the upswing again. TWA has finished discussions with Sud officials in Kansas City (AW June 5, p. 40) and has sent a top-level technical team to France for a further look at the Caravelle. The carrier reportedly is interested in 20 aircraft. Meanwhile, United Air Lines has received the first of its Caravelles and will begin Caravelle service on the New York-Chicago route July 14. Sud needs 225 orders to break even on the Caravelle project, so far has received 116 firm orders.

► **Watch for Air Traffic Control Assn., which recently demanded the resignation of its third executive director in the last five years (AW Apr. 24, p. 41), to abolish the office by constitutional amendment. Drafted by controllers in Federal Aviation Agency's Region I, the amendment proposal would substitute a paid president for the executive director to avoid "any more executive director-president-officers-council brawls." Controllers plan to file their amendment petition before Aug. 30.**

► Los Angeles Airways will be forced to limit its initial order for Sikorsky S-61L twin-turbine helicopters to four instead of the five originally planned (AW Apr. 10, p. 42). The carrier's debt-equity ratio will limit its loan commitment from the Bank of America to $2,891,637, thus restricting the equipment purchase. Sale of additional common stock is under consideration to expand the carrier's capital structure. This could provide funds to finance the fifth S-61 on order.

► **Moscow's diplomatic community was treated to a rare sight earlier this month when Indonesia's President Sukarno flew into Vnukovo, Moscow's international airport, aboard a Pan American World Airways Boeing 707 turbojet transport under the escort of seven Soviet jet fighters. The Pan American Boeing, which served as a backdrop for formal ceremonies arranged for the personal greeting of Sukarno by Soviet Premier Nikita Khrushchev, was chartered by the Indonesian president. Soviets reportedly made unofficial attempts to persuade Sukarno to use a Soviet transport for the trip into Moscow, but Sukarno held to the American charter.**

► Look for Piedmont Airlines to purchase about 15 Martin 404 transports from Trans World Airlines if Civil Aeronautics Board grants Piedmont's petition for routes between Atlanta and Baltimore, Atlanta and Charleston, Knoxville and Asheville, N. C. Initial cost has virtually ruled out buying more Fairchild F-27s to replace the 17 Douglas DC-3s now operated by Piedmont. The last 19 of TWA's 404s were retired Apr. 30.

► **Drastic employment cuts sought by British Overseas Airways Corp. on its wholly-owned subsidiary, British West Indian Airways Corp., are a major factor in moves by the islands of Trinidad and Tobago to take over ownership of BWIA (AW June 12, p. 42). BOAC, concerned over BWIA losses, seeks to eliminate as many as 400 BWIA employes in the West Indies, where unemployment already is a severe problem.**

► Trans World Airlines has decided to equip its turbojet fleet with Collins Distance Measuring Equipment in an effort to comply with Federal Aviation Agency's proposed July 1, 1962, installation deadline. About 10 DME sets manufactured by Federal Electric division of International Telephone & Telegraph Co. have been evaluated by TWA, which intends to sell them to American Airlines.

► **British Royal Aircraft Establishment at Farnborough is cooperating with the French ONERA research organization in designing a supersonic transport in the Mach 2-plus category. M. J. Lighthill, RAE director, said design in progress is aimed at transatlantic operating costs comparable with current large jet transports.**

► Canadair has sold $1.1-million worth of Seaboard World Airlines debentures, to eliminate all its holdings in the airline. Debentures were purchased by major Seaboard creditors as part of the company's reorganization and refinancing plans begun last year.

SHORTLINES

► **Air France** will operate weekly nonstop Caravelle service between Geneva and Algiers from June 26 to Oct. 8 to handle peak summer travel. Winter season flights will stop at Lyon.

► **Alitalia,** the Italian airline, reports its traffic across the North Atlantic increased 93% in May and 103% during the January-May period over the same periods last year.

► **All Nippon Airways** has received the first of six Viscount 810 turboprop transports ordered from Vickers-Armstrongs. The airline, serving its routes with two chartered Viscount 744s, also has six Fokker F-27s on order.

► **British Overseas Airways Corp.** has installed closed-circuit television at New York International Airport to brief pilots and crews on international weather conditions.

► **Civil Air Transport** of Formosa has received a Convair 880M turbojet transport and expects to have the aircraft in service between Taipei, Tokyo, Seoul, Manila, Hong Kong and Bangkok by July.

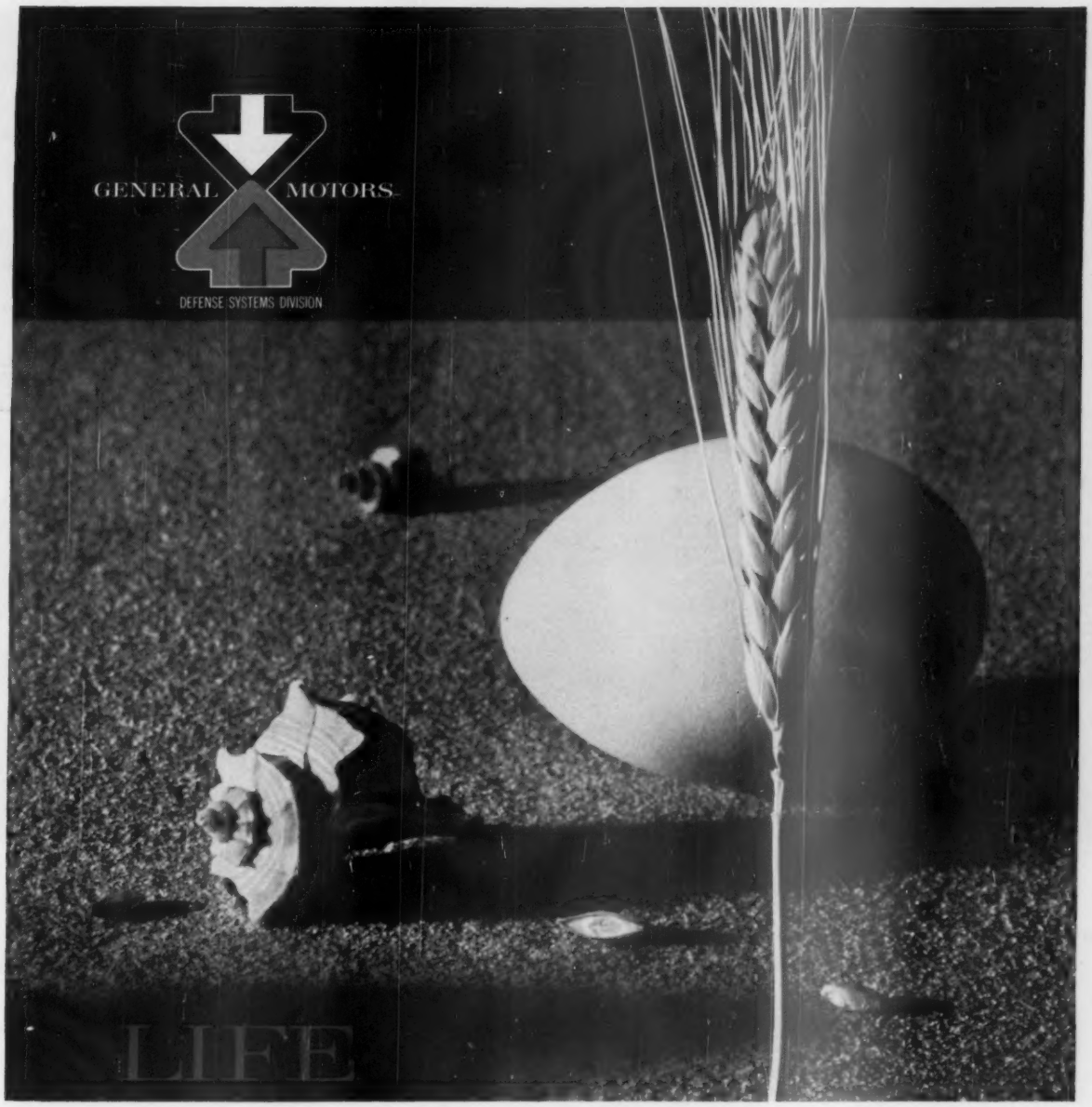
► **KLM Royal Dutch Airlines** has extended its Zurich-Casablanca-Las Palmas-Conakry-Monrovia service to Accra, Ghana, and has increased this Electra service to two flights a week. KLM also has introduced the Electra on its Zurich-Tunis-Lagos-Accra route.

► **Pan American World Airways** is helping to finance a new hotel in Frankfurt, Germany, which will cost $10 million, accommodate 1,000 guests and be completed in the summer of 1963.

► **Riddle Airlines** will expand its fleet of Douglas DC-7Cs by purchasing three additional aircraft from Northwest Airlines. Converted to DC-7CF configuration by Douglas, the aircraft are scheduled for delivery this month.

► **Southern Airways** reports it carried 33,884 passengers 6 million passenger miles during May, an increase of 8% over the same period last year.

► **United Kingdom** business firms are expected to make a concerted effort to get parliamentary support to reopen London's Croyden Airport, now closed as an economy measure. They want Croyden developed as a business aircraft airport similar to the field at Teterboro, N. J.



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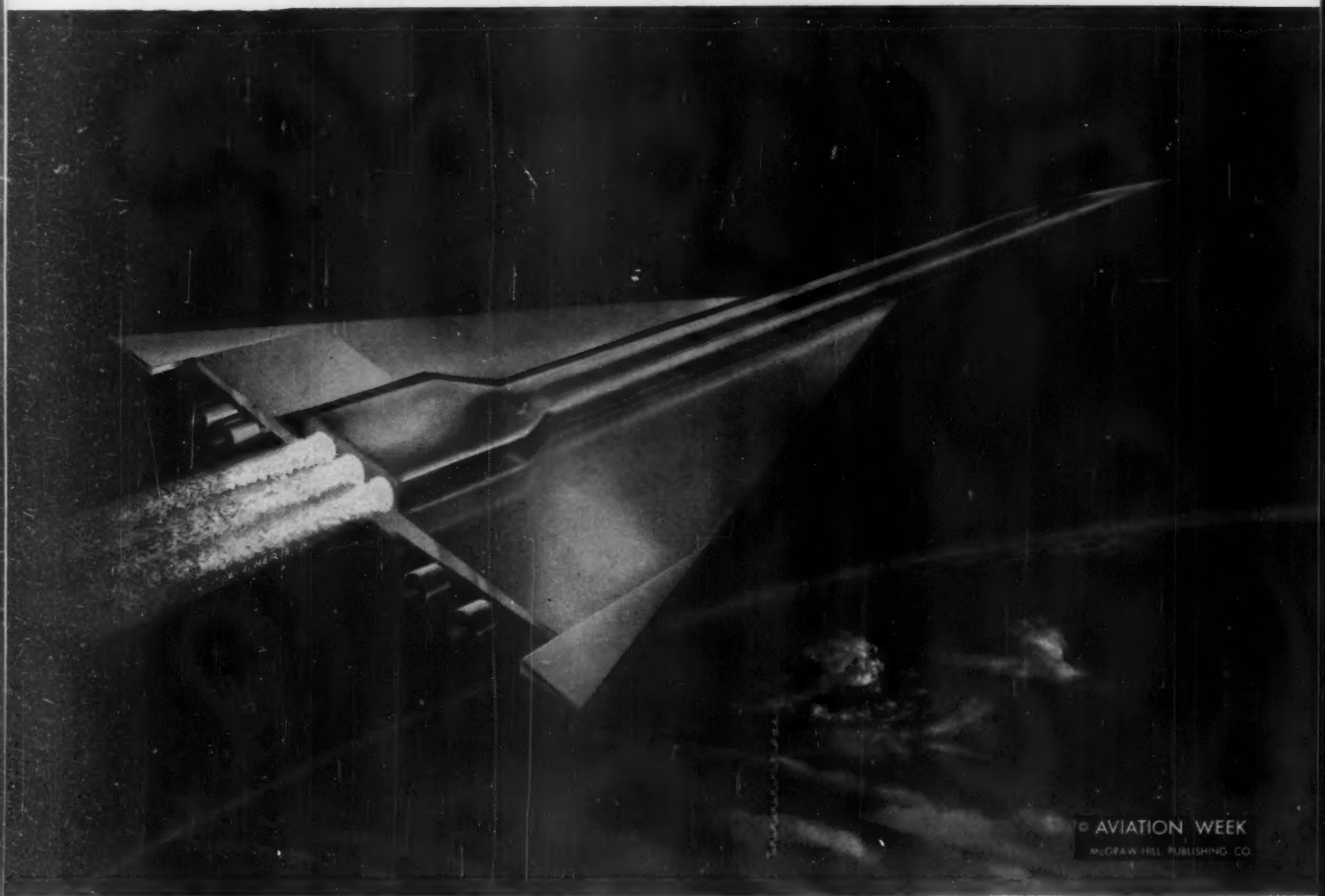


DIFFERENT IDEAS have been expressed on how Aerospace Plane will be propelled and how it will gather air for storage, but the airframe design will follow principles developed for hypersonic flight which call for square trailing edges and aerodynamic surfaces to permit normal takeoff, flight and landing. Air Force originally designated the aircraft Space Plane.

Space Plane Grows Into Family of Concepts

By Larry Booda

Washington—Technique of achieving orbital flight in a single stage from the surface of the earth with an air scooping vehicle has survived severely critical feasibility studies and has grown into a whole family of concepts from what originally were a few isolated approaches aimed at avoiding the use of multiple boosters.

A series of parallel studies over the past two years, all based on the principle of air recovery and storage for propulsion coupled with aerodynamic flight in the atmosphere, are now being evaluated by the Advanced Research Projects Agency for the director of defense research and engineering.

Since President John F. Kennedy has committed the National Aeronautics and Space Administration to an all-out effort to beat the Russians to the moon, and NASA itself has devoted most of its effort to the multiple stage launch vehicle approach, the Defense Department is the principal U.S. agency interested in the air scooping vehicle as an alternate possibility.

What the Air Force at first called Space Plane (AW Oct. 31, p. 26), and later Aerospace Plane, is really a number of different proposals employing a variety of propulsion forms, flight profile techniques and vehicle designs.

High Industry Interest

Interest generated by the air scooping vehicle is so great that studies have been conducted by every major airframe and propulsion contractor, and many smaller companies have submitted their ideas to the Defense Department.

A few studies have been funded by ARPA and the Air Force, but most have been company-financed with a view to capturing business a decade from now. The great number of ideas developed has helped put somewhat of a damper on the tendency toward any headlong approach along a simple line.

Scientific and technical officials concerned are careful to point out that the final answer will depend on additional applied research, years of step-by-step development and coordination of work in a wide variety of fields. These include hypersonic aerodynamics, dynamics of rarefied gases, advanced chemical and electrical propulsion techniques, accurate celestial space navigation, thermodynamics and the life sciences.

With so much interest shown by industry and with the Air Force seeking a bigger military role in space, including manned systems, the single-stage-to-orbit concept was subjected to at least four feasibility studies matching it to all facets of the state-of-the-art by ARPA and its parent Office of Defense Research and Engineering since last summer. Attempts were made to discredit the idea, but they failed.

The principle of the air scooping vehicle is based on collecting air at high

altitudes, compressing and liquefying it, separating the oxygen from the nitrogen and then burning the oxygen with liquid hydrogen inserted in the vehicle before takeoff.

Since it takes eight times as much liquid oxygen as liquid hydrogen by weight to supply the proper propellant combination, the vehicle could takeoff at about half its upper atmosphere flight weight. The weight of the oxygen in the vehicle could be from 80 to 88% of the total propellant weight after collection.

Presumably, this type of vehicle would be able to take off from an ordinary runway, fly to the upper atmosphere, take on a load of oxygen and then act as an orbital tanker and supply station for other vehicles or proceed on its own mission to a soft landing on the moon and return. Not much capability is claimed as a possible vehicle for traveling to other planets, but as a near-space launching platform it appears promising.

The complexities of the vehicle itself and its subsystems—vehicle borne, earth stationed, and even space stationed—combined with the operating environment, are estimated variously as an order of 100 to 1,000 times as difficult to solve as the World War II Manhattan Project which produced the atom bomb.

Data From Other Projects

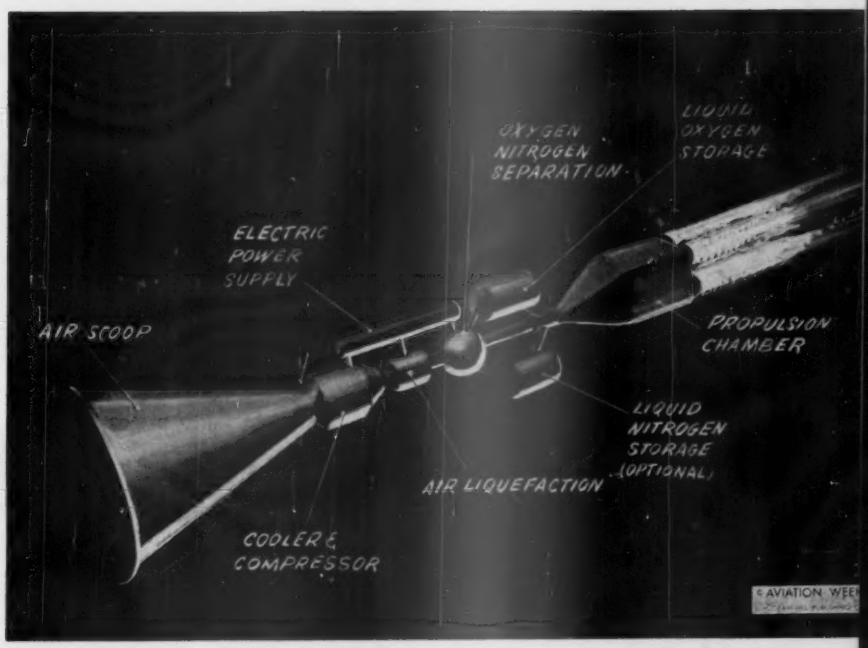
Any specific project growing out of the studies will depend on the knowledge gained in some aspects from current projects. The two which will produce the most information are the X-15 supersonic research aircraft which has flown 3,307 mph. and the Dyna-Soar hypersonic boost-glide vehicle. Dyna-Soar, which will be launched by conventional rocket boosters, will re-enter the atmosphere unpowered at hypersonic speeds.

Proposals break down generally into four types of flight for the air collection cycle. Propulsion proposals run the gamut of turbojets, turbo-ramjets, subsonic flow ramjets, open under-wing ramjets, supersonic flow ramjets, gaseous oxidizer closed-cycle ramjets, liquid oxidizer-fuel nozzles, and electric arc, ion, photon and magnetohydrodynamic acceleration.

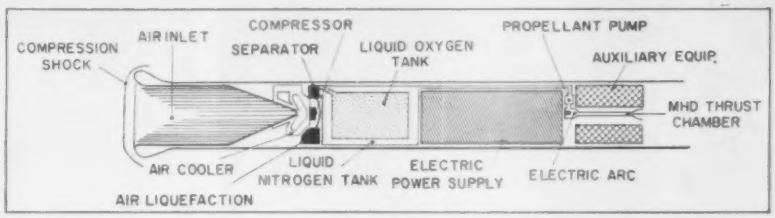
Power supplies suggested vary from batteries and solar collectors to various forms of nuclear fission and fusion power systems. It is even suggested that power could be obtained from reassociation of dissociated air molecules in the ionosphere.

Simply multiplying the four types of flight by the variety of propulsion combinations indicates how many ways there are to design a vehicle.

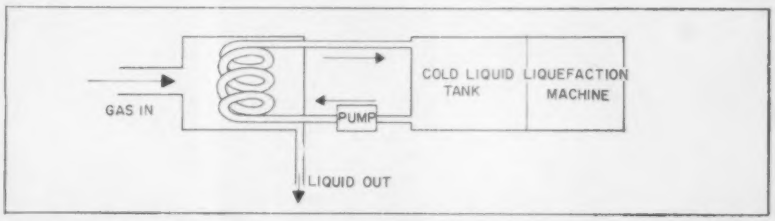
One approach for collecting air involves aerodynamic flight at hypersonic



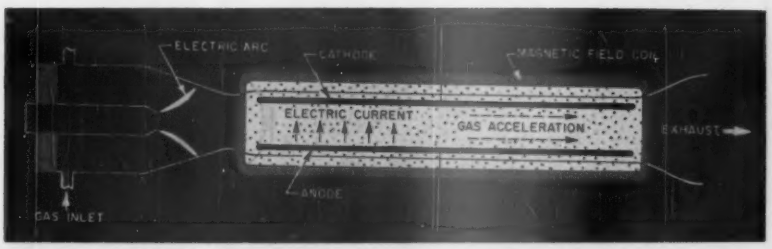
AIR SCOOPING vehicle internal system would have the air scoop, a cooler-compressor, air liquefaction plant, oxygen-nitrogen separation, electric power supply, oxygen and nitrogen storage and a propulsion unit. One proposed vehicle looks like this drawing.



INTERNAL components of an air scooping satellite which would use magnetohydrodynamic acceleration would be arranged as shown in above diagram.



CRYOSTAT method of air liquefaction uses successive stages of compression and cooling until liquid oxygen is formed. If required, liquid nitrogen, which condenses at a lower temperature, can be produced. Problem of heavy equipment must be surmounted.



MAGNETOHYDRODYNAMIC accelerator is the concept closest to practical application for orbital and space propulsion. Nitrogen is heated by an arc and passes into a chamber, where an electric current passes through it and a magnetic coil accelerates it to produce thrust. Airborne MHD accelerator might operate at 4,000K.

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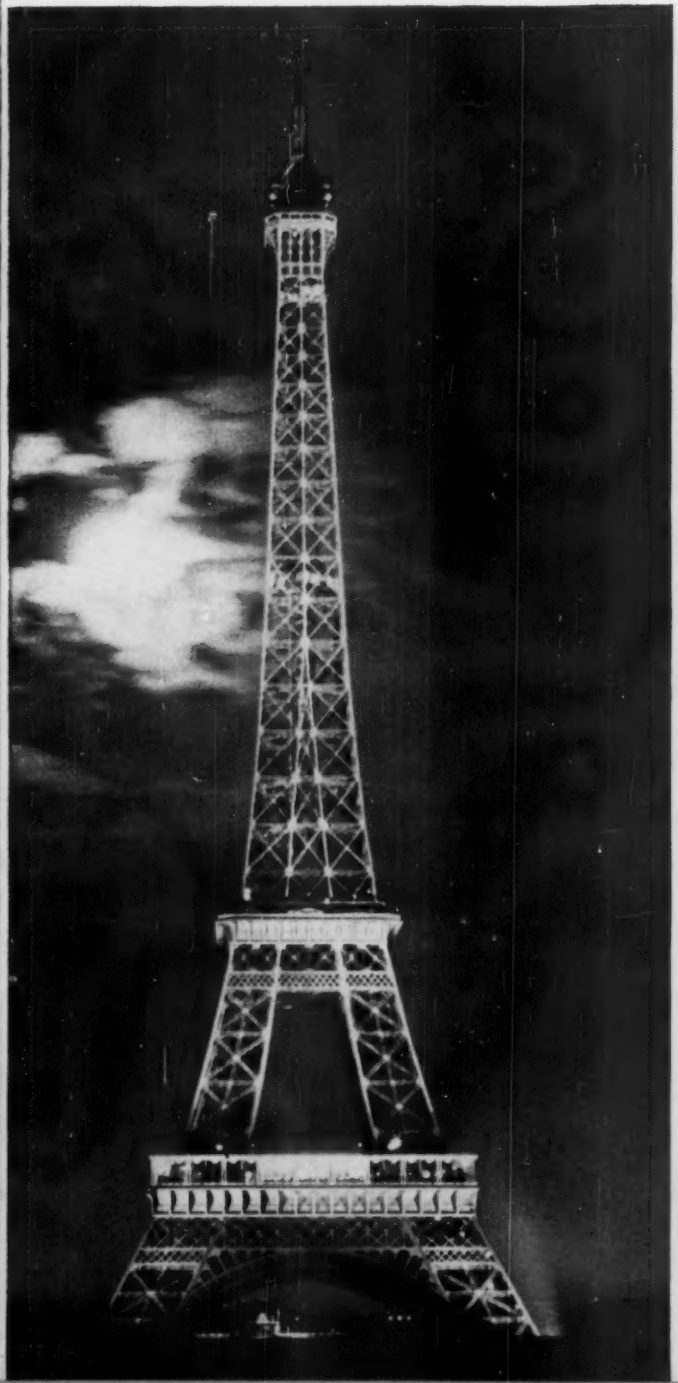

STILL A NEW IDEA

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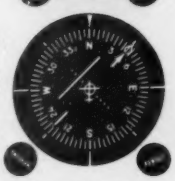

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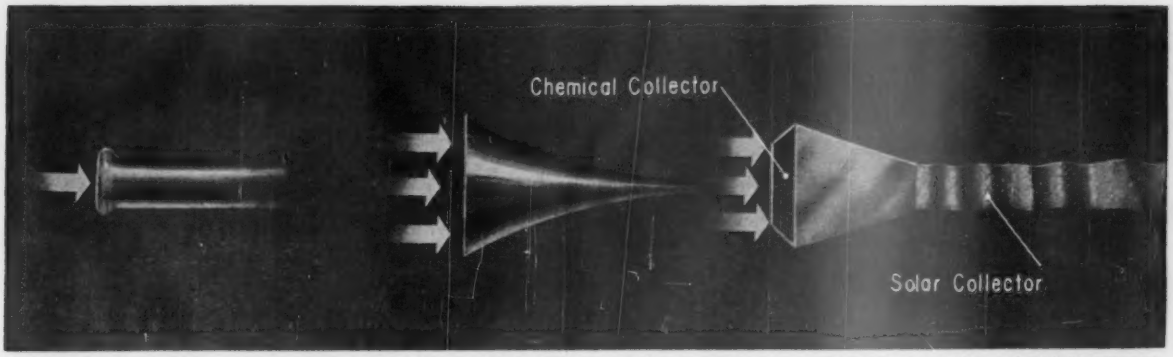


INLET at left shows the scoop shape most ideal for an elliptical orbit air gathering cycle, scooping between 250,000 and 280,000 ft. altitude. Center inlet shape would be for operation in a circular orbit from 325,000 to 360,000 ft. Both of these would operate in regions of continuum air flow. Configuration of inlet at right would be for operation above 550,000 ft. where there is molecular air flow. Air would be gathered by adsorption, and power would be provided by a solar collector curtain.

speeds between 100,000 and 120,000 ft. altitude. The upper altitude limit for aerodynamic flight is about 150,000 ft.

At these altitudes, the drag produced in maintaining lift and by the air scoop would require high engine thrust. Thus the air scooping cycle would have to be short because of limited fuel endurance. This flight profile would also require a high capacity internal power supply to operate the air reduction plant.

Because of the high thrust required, combined with the problems of heat dissipation from aerodynamic heating and operation of the power supply and reduction plant, this method has fewer adherents than the others.

A second approach envisions an elliptical orbit whose perigee would be about 250,000 ft. During flight in this region, say from 360,000 to 250,000 ft., there would be a concentrated period of air collection. The scoop would be a straight cylinder.

As with the first concept of collection at 100,000 to 120,000 ft., the power requirements for the collection period would be so great that whatever power supply system was used, it would be prohibitively heavy. This could be batteries, recharged from solar collector cells, from fuel cells or from nuclear power units.

Circular Orbit Concept

Another idea, which has survived more feasibility studies, is one which prescribes a circular orbit between 325,000 and 360,000 ft.

This vehicle could operate from a nuclear power supply, simplifying the entire system by eliminating storage batteries and using heat sinks to capture heat generated by the concentrated scooping cycle.

At these altitudes the design of the vehicle and the scoop are highly critical, because pressure interactions along the side walls would create undesirably high drag. For this reason, the scoop design would be more of a tapered shape.

These three schemes are predicated on continuous flow of air over vehicle and scoop surfaces. Above 360,000 ft., this continuum flow begins to change to molecular flow so that ram scooping is no longer possible.

There is another concept which would provide collection of air molecules by adsorption in a carrier fluid or substance. This would operate in the region above 550,000 ft. Its shape would be dictated by its solar collector power supply. It could be rectangular so the body could carry a solar collector curtain which would be unfurled after orbit is achieved.

Collection Cycle Propulsion

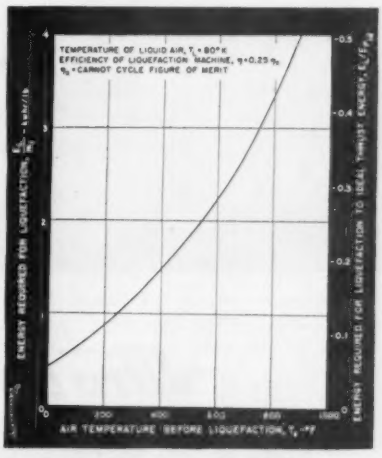
Each of these concepts obviously requires a means of propulsion during the collection cycle, and all combustion engines proposed would burn liquid hydrogen and gaseous or liquid oxygen.

During its development life, which is now more than 20 yr., the turbojet has increased its capability from subsonic flight to the region of Mach 3. The ramjet in its present form can go to Mach 7, but must be accelerated to its starting speed, so it cannot be used for takeoff.

A combination of the two, called the turboramjet, has the ramjet placed behind the turbojet engine. For takeoff and high power requirements to Mach 3, the two would operate as a turbojet with an afterburner. When the compressor blade speed limits are reached in the turbojet, it would be closed off and the ramjet would be able to function up to Mach 7.

For air scooping at 100,000 to 120,000 ft., the ramjet would provide the hypersonic flight needed. This would require use of a considerable amount of the stored liquid hydrogen and would reduce the payload for orbital flight or transfer to another vehicle.

The jump from hypersonic flight speeds to the speeds needed to achieve orbit requires different propulsion techniques.


TEMPERATURE OF LIQUID AIR, T_L = 80°K
EFFICIENCY OF LIQUEFACTION MACHINE, η=0.25 η_c
η_c = CARNOT CYCLE FIGURE OF MERIT
ENERGY REQUIRED FOR LIQUEFACTION, E_L - kwh/lb
ENERGY REQUIRED FOR LIQUEFACTION TO IDEAL THRUST ENERGY, E_L/TF_id
AIR TEMPERATURE BEFORE LIQUEFACTION, T_a °F

ENERGY required for air liquefaction versus temperature of air before liquefaction is indicated here.

Rocket Uneconomical

The most obvious method, and one which is available now, is the nozzle rocket system. This would be uneconomical, however, in that it would need liquid hydrogen and liquid oxygen for operation. Thus, takeoff with an appreciable load of liquid oxygen would be required, or a pause would be necessary along the way to scoop in sufficient air for the next cycle orbit.

A simpler powerplant is within the state of the art, however. The present ramjet reduces air flow into its chambers to subsonic velocity, no matter what the external speed is. A theoretical alternative on which there has been some research and a little development is the ramjet which uses supersonic internal flow.

Considerable work would be necessary in the dynamics of supersonic flow-flame propagation. If it were provided a

Wire

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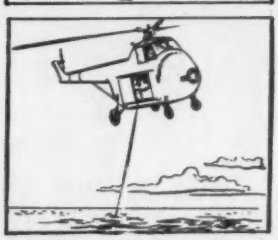

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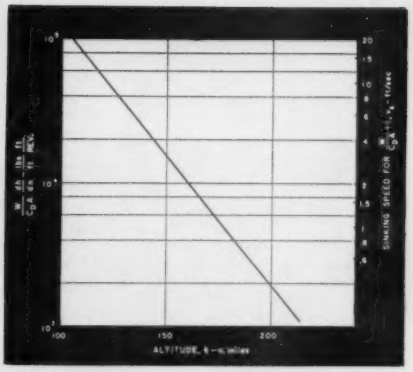
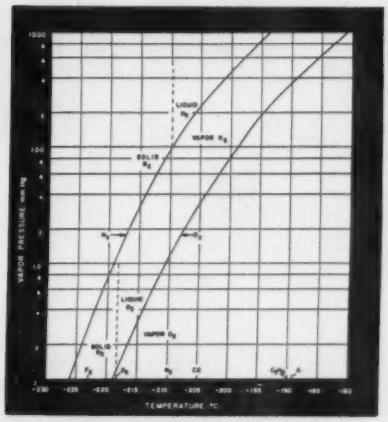
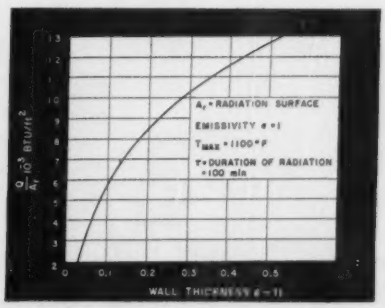


ALTITUDE loss versus altitude of circular orbits is shown here. The scale at right shows the sinking speed of a vehicle in an orbit of 5,000 sec.



VAPOR pressure of oxygen and nitrogen versus temperature is shown. Melting points of several substances are included.



MAXIMUM amount of heat that can be stored per unit surface area of tubular heat sink versus thickness of heat sink is indicated in the above chart.

separate, extensive development program the supersonic flow ramjet is considered capable of success. Instead of being limited to Mach 7, it could operate fast enough to accelerate to the 25,000 fps. needed for orbital flight.

Once orbital flight is achieved at air scooping altitudes, it is considered uneconomical to burn the scooped air for propulsion rather than liquefying it.

The system closest to practical application for flight beyond orbital speeds is the magnetohydrodynamic accelerator. This device would require storage of liquid nitrogen in addition to liquid oxygen. However, air liquefaction systems can easily convert both from air. MHD would also require a nuclear power supply.

The magnetohydrodynamic accelerator uses the principle of superheating a gas to the point where it is ionized, and then accelerating it with a magneto coil. In ground test installations these gases can be heated to 16,000K. The gas could melt the container walls, but it is kept away from them by the magnetic field.

For a flight installation, a low temperature MHD accelerator, operating at about 4,000K would be practical. The nitrogen would be introduced past an electric arc which would heat it. An alkali metal vapor, such as calcium, sodium or potassium, 1% by volume, would be introduced to make the gas a better conductor of electricity.

It would be choked in a nozzle to accelerate it to a low supersonic speed, then sent past the entrance to an acceleration chamber which can be either a cylindrical or a rectangular cross section duct. Field coils then produce a magnetic field across the duct. A direct current is passed through the gas between electrodes, and in the presence of the magnetic field this current produces a force which accelerates the gas, thus producing a thrust.

A theoretical system which might be applicable is the monatomic ramjet. Due to action of particles and rays from the sun, upper atmosphere molecules are dissociated, or ionized. This state represents stored energy. If the ionized air can be properly gathered and associated, energy in the form of heat will be released. In theory, a monatomic ramjet could operate without fuel, using only the energy stored in the upper atmosphere. If developed, it could readily be applied to a space plane.

Another possibility besides the MHD accelerator for reaching the moon in minimum amount of time, would be use of a variation of the ramjet. When ready to leave orbit and gain escape speed, the ramjet front end would be closed. Then it could be operated by introducing gaseous oxygen, which would burn with liquid hydrogen sprayed from the flameholder. One company claims this method is the answer to the complex plumbing of nozzle rockets.

The four types of air collection flight cycles are tied to different time schemes for doubling their weight. The 100,000- to 120,000-ft. profile would have the mission accomplished in hours, but it would be hampered by its inherent dif-

Engineered Environment

The cocoon is a masterpiece of Nature's environmental engineering. It is insulated against heat and cold, waterproof and shockproof, and is equipped with a built-in air filtering system.

As snug as a cocoon must be the protection afforded delicate instruments that function in mobile equipment. This points up another AAF capability — "packaging" of mobile electronic checkout equipment. We have designed compact, four-wheel trailers used in checkout of the F-101 and B-58, and for the B-47 ERS system. For example, the B-58 checkout cart is designed to be shockproof, dustproof and waterproof, and includes an AAF air conditioner to environmentally condition the installed electronic gear. Space-saving compactness is an outstanding design feature.

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ficulties. The elliptical orbit method would be on the order of hours also, but it is considered economically unsound.

Circular orbits, using nuclear power, offered the best method of collection from the standpoint of economics. The collection cycle would be in the order of days, and it could be repeated many times.

The vehicle in the upper reaches of the atmosphere where there is molecular flow would probably be unmanned and capable of operating for years.

Without considering development expenses, proponents claim that the cost of launching Aerospace Plane into orbit would be about $100 per pound, much less than the cost of rocket boosters available now.

One of the problems which will tax the skills of thermodynamics engineers will be the liquefaction of air and its separation into nitrogen and oxygen.

Air entering any liquefaction system must be at a pressure of 10 cm. of mercury or more and a temperature below 600K. In the ordinary cryostat method of liquefaction, successive cycles of compression, cooling, recompression and cooling are used. This is a mechanical system, requiring moving parts and complex plumbing and cooling equipment. It also is heavy.

Other methods of compression are being developed, however. Various means of creating shock waves can be used for compression, among them the electric spark.

To separate oxygen from nitrogen, if both are to be kept in liquid form, a centrifugal separator, similar to a cream separator, must be used. If oxygen alone is to be kept in liquid form, it alone can be liquefied since its boiling point of −183C is above that of nitrogen, which is −195.8C. Oxygen thus will liquefy first in the cooling cycle.

For short-term operations, fuel cells offer an attractive method of providing electrical power. In this method, the fuel is converted directly into electrical energy by electro-chemical means.

For longer-term operations coupled with heavy power demands, a nuclear power source is required. Steady developments in this line, such as the Snap series, promise lightweight space power systems.

Present conceptions of the entire space vehicle show aerodynamic surfaces with blunt trailing edges. Techniques for re-entering the atmosphere have yet to be tried. Too steep a re-entry path would burn the vehicle, too shallow a path would result in too little deceleration, allowing it to escape again, with the necessity of having to use power to return.

Landing of Lunar Vehicles Studied

Safest lunar landing areas will be the convex marias, and the most dangerous would be the slopes of craters, according to N. A. Weil of the Armour Research Foundation.

Weil says landing a manned vehicle or an instrumented package on crater slopes could set off a disastrous dust avalanche. Crater rims and highlands are likely to be bare rock, he said, but dust up to a thickness of several hundred feet may be encountered on crater floors. Weil discussed these factors in a report prepared for the First International Conference on the Mechanics of Soil-Vehicle Systems, in Turin, Italy.

Weil outlined these moon landing alternatives for both manned and instrumented packages:

• **Lunar seas:** reasonably smooth and wide open, and comparatively easy to reach without a precise control system. Vehicle could settle into the thin dust, with the landing retrograde rocket scattering some of it.

• **Crater floors:** poor landing area because the vehicle could be "swallowed" by the thick dust layers.

• **Highlands:** although landing on the exposed rock would entail the least number of unknowns, the highlands make up only a small portion of the lunar surface. Guidance problems for this alternative are difficult, and the weight penalty for a hard surface landing is high.

• **Slopes:** covered with dust in a constant state of downhill migration under the pressure of reflected sunlight, solar proton bombardment and lunar gravitation. Any substantial disturbance, such as seismic activity, impact of large meteors or landing instrument packages, might set off a huge dust avalanche.

Weil said crater bottoms probably are filled with dust strata, which may be more compacted in the lower layers. He said crater bottoms may be hard because of the weight of the upper layers, lack of electrostatic charging, and absence of gaseous or liquid lubrication.

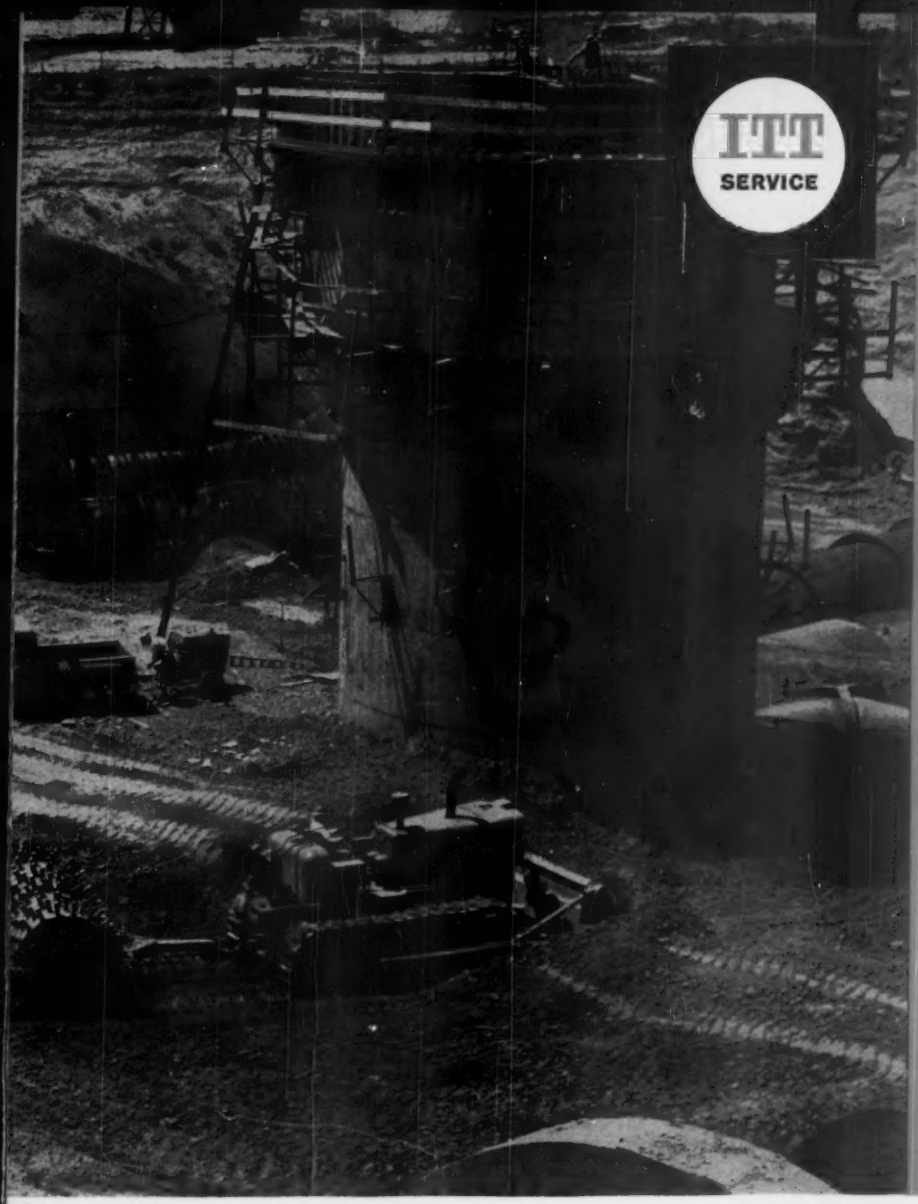
Bottom layers may be cemented by moisture, originating mostly from impacted meteors, he said.

Lunar dust is likely to consist of metallic and non-metallic stone and metallic meteorites. Fine dust, Weil said, is at least 40% silicon dioxide interspersed with iron-nickel particles from iron meteorites.

Weil also summarized the probable surface conditions of these terrestrial planets:

• **Mercury,** which has a rugged, dust-covered surface with an atmosphere of 0.2 mm. of mercury. Sun-oriented side may hold molten pools of zinc, tin or

■ Federal Electric Corporation President, J. W. Guilfoyle (on left), inspects typical underground passageway during initial phase of the complex's activation by FEC.



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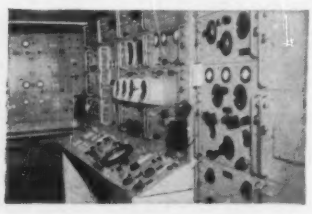

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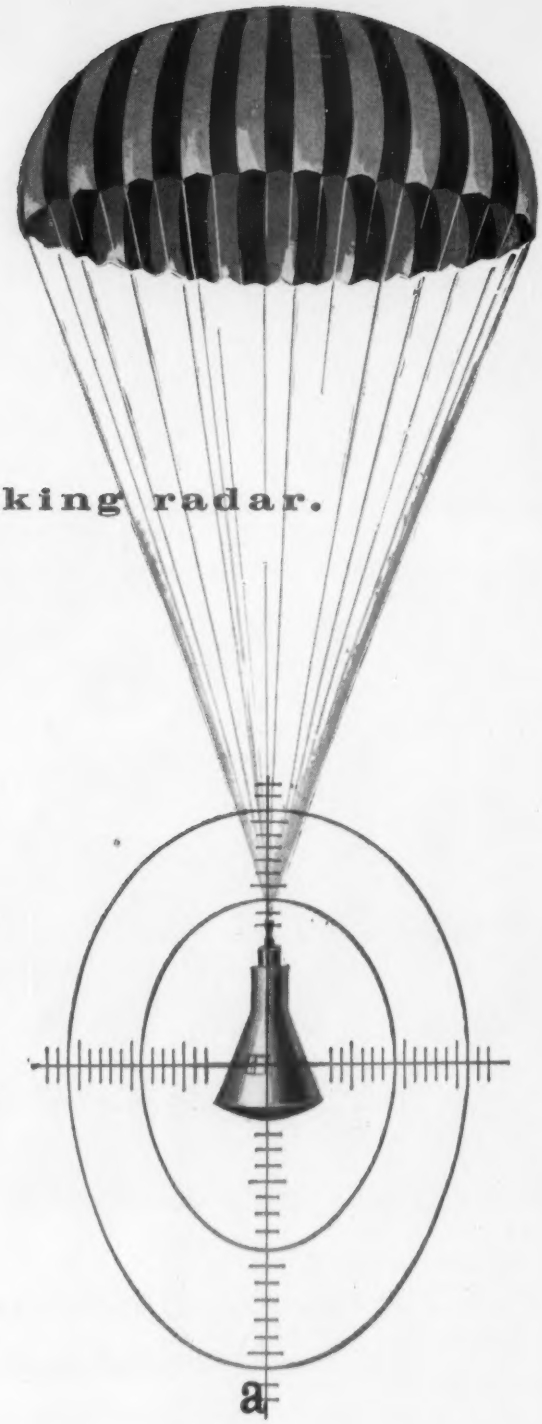

a
life
line
to
earth

for the astronaut...

mercury. Dust layer is thin, probably about 4 in.

• **Venus** has a 300C temperature overlaid by an atmosphere with a surface temperature of 1,500C. Atmosphere probably is composed of carbon dioxide, carbon monoxide, nitrogen, methane, oxygen and possibly water. Violent storms and deep dust beds characterize the surface.

• **Mars'** surface is dry desert land consisting of granulated or powdery iron oxide. Thin layer of vegetation covers 25% of the surface, and thin ice caps are at both poles. Atmosphere is 0.1 the density of the earth's, and probably consists of nitrogen, carbon dioxide, carbon monoxide and noble gases.

System Devised to Map Moon's Gravity Fields

Surveying device to map gravitational fields of the moon or planetoids with lunar-type atmospheres has been proposed by Astra, Inc., Raleigh, N. C.

Basis of the scheme is the Mossbauer effect—the discovery that low-energy gamma rays can be produced to have a very narrow frequency spread. This discovery, which has been used to make laboratory measurements of the gravitational red shift of light, has been adapted to a similar concept in the moon-mapping instrument.

Astra proposes that this monofrequency gamma radiation be used with a superimposed doppler effect to determine frequency shifts caused by differences in the lunar gravitational field. The unit uses a movable emitter of the gamma radiation, a non-radioactive absorber made of the same material as the emitter and a radiation-intensity detector.

The gamma source, Cobalt 57 of approximately 0.5 curies strength, would be mounted at the rim of a rotating wheel with a variable-speed drive. The basic frequency distribution pattern at the wheel is then a function solely of the doppler effect on the single-frequency gamma radiation.

The absorber is placed some surveyed distance away, and receives the frequency-modulated radiation. The difference between the incident radiation and the resonant frequency of the absorber determines the intensity of the received radiation and gives the clue to the frequency shift.

Emitter and absorber would be kept at the boiling point of liquid nitrogen for two reasons: First, radiation frequency is dependent on temperature, but low temperatures have least effect on the frequency. Second, temperature of absorber and source can be equalized by control of the nitrogen pressure.

Total power requirement for the system is estimated at about one kilowatt.

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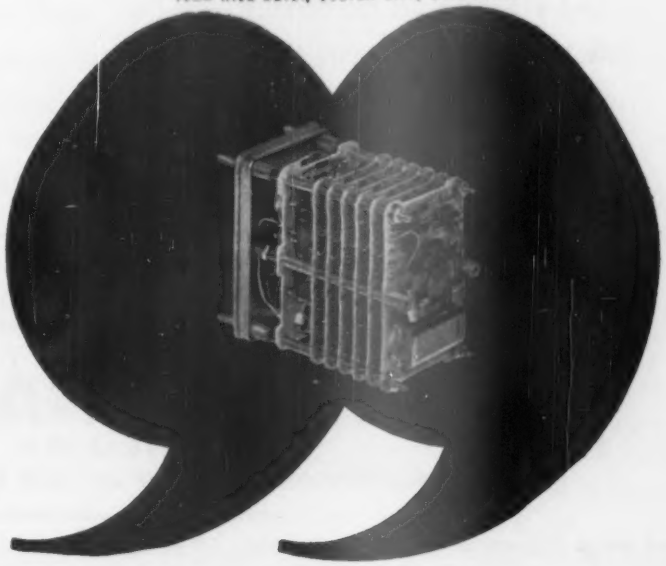

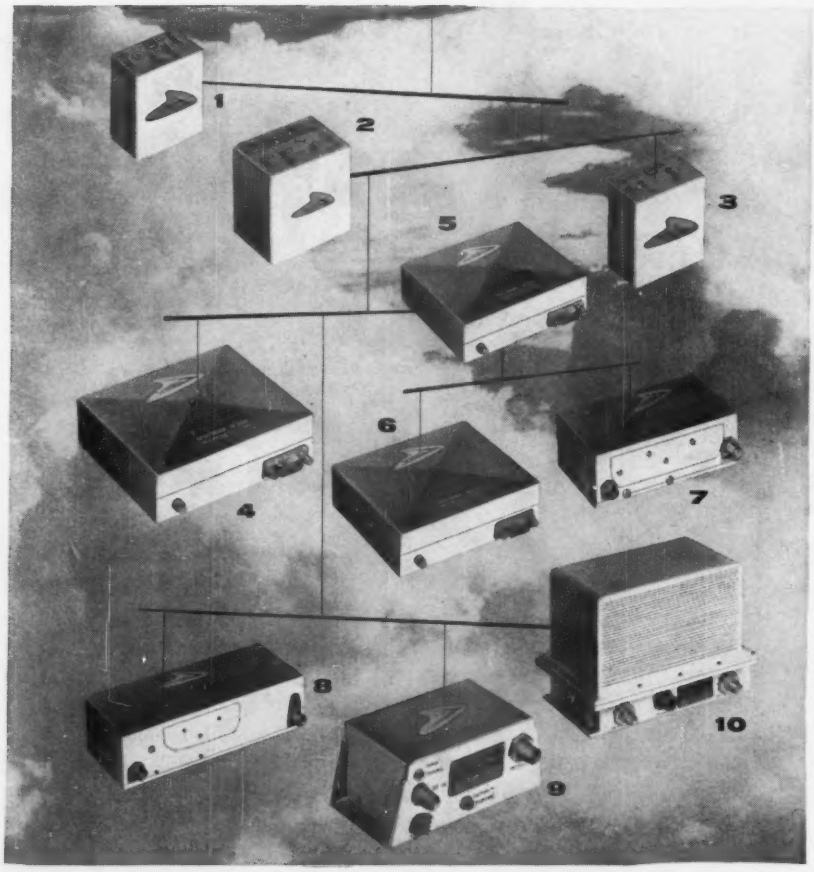

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Astronauts Discuss Mercury Training

Project Mercury Astronauts Alan B. Shepard, Jr., and Donald K. Slayton discussed the training, preflight and flight aspects of the Mercury-Redstone 3 operation during the recent Conference on Medical Results of the First U. S. Manned Suborbital Space Flight (AW June 12, p. 31). Because of the importance of this advance in the national space program, AVIATION WEEK *is publishing their reports.*

SLAYTON REPORT

All phases of the Astronaut training program are discussed herein, including the generalized areas pointed toward all rocket flights and the specialized aspects pointed directly toward the MR-3 flight. Initially, the original qualifications of the trainees should be given. Each is a highly qualified jet fighter pilot who graduated from one of the service test-pilot schools and has experience as an experimental test pilot. Each has a bachelor's degree in engineering or one of the basic sciences, is physiologically and psychologically sound, and is in good physical condition.

Since no ground rules existed for the training of Astronauts at the inception of this program, three basic philosophies were adopted:

- **Utilize any training device or method** which has even remote possibilities of being of value.
- **Make the training** as difficult as possible with these devices even though analytical studies indicate the task is relatively easy.
- **Conduct the training** on an informal basis except in the interest of intelligent scheduling of instructor and trainer time since we were all assumed to be well-motivated mature individuals.

The training program can be broken down into five major categories as a function of training devices. These categories are academics, static training devices, dynamic training devices, egress and survival training, and specific mission training.

Academics

All of us needed to brush up on basic mechanics and aerodynamics. In addition, prior to this training we had been only briefly exposed to many fields of science such as astronomy, meteorology, astrophysics, geophysics, space trajectories, rocket engines, and physiology. Instructors for these subjects were drawn from the scientists of the Langley Research Center and the Space Task Group. For example, one of the scientists of the Space Task Group gave us a lecture on the principles of rocket engines and rocket propulsion. Dr. William K. Douglas gave us a series of lectures on physiology designed to give us a better understanding of the physiology and construction of the human body, a subject of which we had little knowledge prior to this program. One of the subjects he discussed was the effect on the body of various g-loadings obtained during flight and landing impact.

In addition to the lectures on basic astronautics, we were given detailed systems briefings by the McDonnell Aircraft Corporation engineers concerned with the design of the various subsystems. Also, the engineers within the Space Task Group who were concerned with the various individual systems gave us detailed briefings and continuously brought us up to date with the changes occurring to these systems. Our knowledge of these systems was gained both from formal briefings and from our attending coordination meetings in which these systems were discussed and changes to them made.

As a supplement to the classroom or academic work, we also made many field trips as a group. One such field trip was a visit to the Convair Astronautics Division of the General Dynamics Corporation in San Diego, Calif., where we observed a test facility where the components of the Atlas are tested. We also went to the McDonnell Aircraft Corporation, manufacturers of the Mercury spacecraft, where we had our first look at the mock-up of the spacecraft, and at the basic spacecraft structure and its subsystems being assembled.

As a result of this initial visit, we were able to make many recommendations for changes to the cockpit layout and instrument panel, and to recommend incorporation of a single large window and an explosive side hatch for escape. We went to the Redstone Arsenal at Huntsville, Ala., where we observed the Redstone launch vehicle being constructed and checked for flight.

Other Facilities Visited

We also went to Rocketdyne where we observed rocket engines being constructed and tested. As a group, we visited practically every facility directly concerned with the launching of the Mercury spacecraft. In addition, as individuals, we probably visited every subcontractor involved in the program.

It was obviously quite early in the program that the program was too complex for all of us to command a knowledge of all the detailed aspects of the spacecraft, launch vehicles, and flight. Therefore, by each of us assuming responsibility for one major area, we were able to maintain detailed contacts with all aspects of the program. The following table [below] shows the assignment of specialty areas:

As an example, I was assigned the Atlas launch vehicle. Where possible, I attended all meetings concerned with mating of the Atlas launch vehicle with the Mercury spacecraft and with modifications to the Atlas launch vehicle which affected our mission. In addition, I observed many Atlas research and development launchings to note procedures which might require change for manned operations. It was then my duty to report my findings and the results of my trips to the rest of our group in order to keep them up to date with the progress of the Atlas.

Each of us did the same in his particular specialty area.

A valuable byproduct of the assignment of specialty areas was the ability to get an Astronaut input into the design of each of the systems involved in Project Mercury. We operated essentially in the same manner as the experimental test pilots who work for an aircraft company; we followed through the design phases of our particular area to insure that no obvious operational aspects were overlooked.

Static Training Devices

The next set of training devices used were the fixed-base or so-called static trainers.

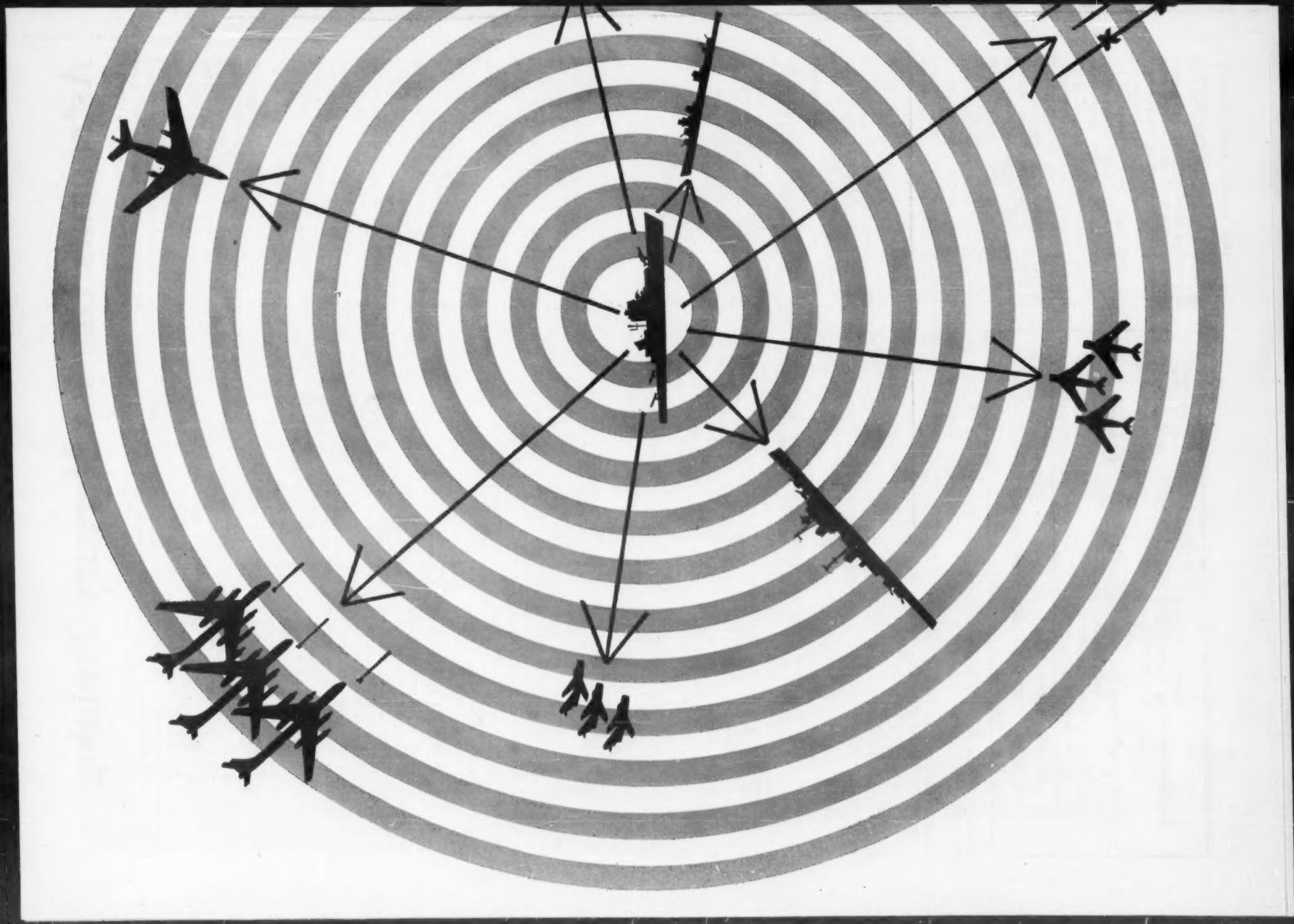
The first devices were the series of procedures trainers. One early approach used for practicing of retro-maneuvers and re-entry maneuvers consisted of an analog computer tied in with a locally constructed hand controller and prototype flight instruments to allow us practice in flight control while we were waiting for the production procedures trainer. A modification of that device used the Mercury hand controller and flight instruments and was driven by an F-100 gunnery simulator computer. We could operate this trainer on a contour couch and in a pressure suit, and gain further training in retrofire and re-entry.

The final production procedures trainer was constructed by McDonnell Aircraft Corporation. The instructor sat in the outer control console of the procedures trainer. The instruments in the outer control console are essentially the same as within the procedures trainer itself, so the instructor can follow the motions of the pilot onboard. In addition, the instructor is capable of creating any failure mode or emergency that it is possible to encounter with the vehicle, either singularly or in combinations. With this device we have learned to cope with every possible emergency that can occur by developing skill in rapid trouble-shooting and in taking the appropriate corrective actions.

In addition to use of the trainer for learning modes of failure and corrective

Astronauts' Specialties

Astronaut	Specialty area
Malcolm S. Carpenter	Navigation and navigational aids
Leroy G. Cooper	Redstone launch vehicle
John H. Glenn	Crew space layout
Virgil I. Grissom	Automatic and manual attitude control system
Walter M. Schirra	Life support system
Alan B. Shepard	Range, tracking, and recovery operations
Donald K. Slayton	Atlas launch vehicle



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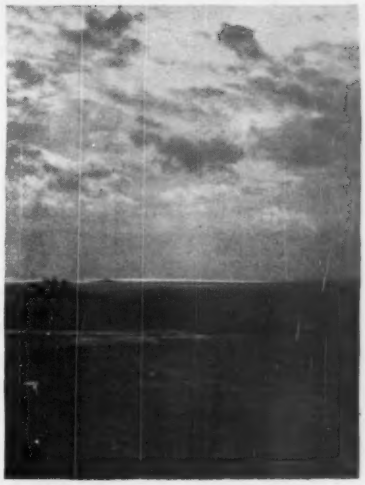

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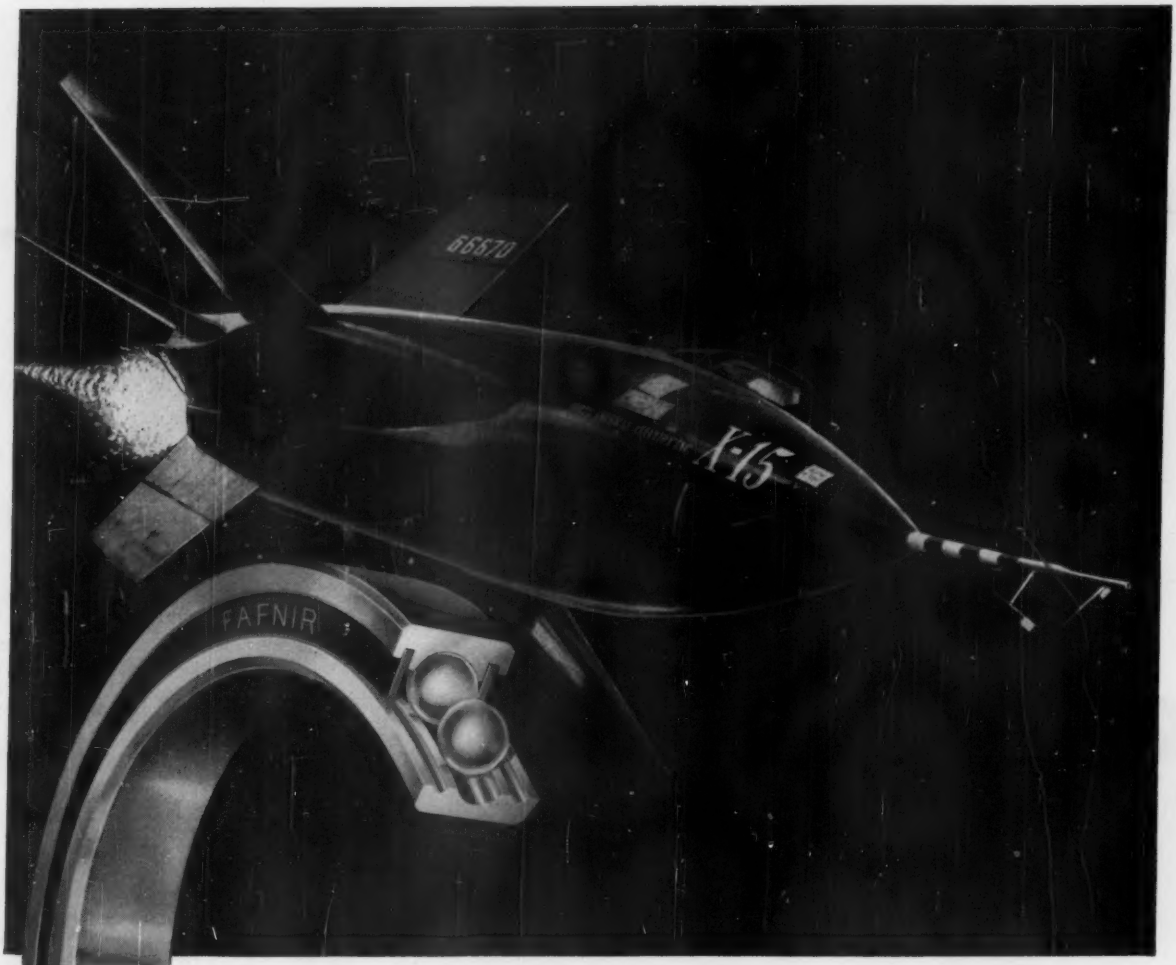

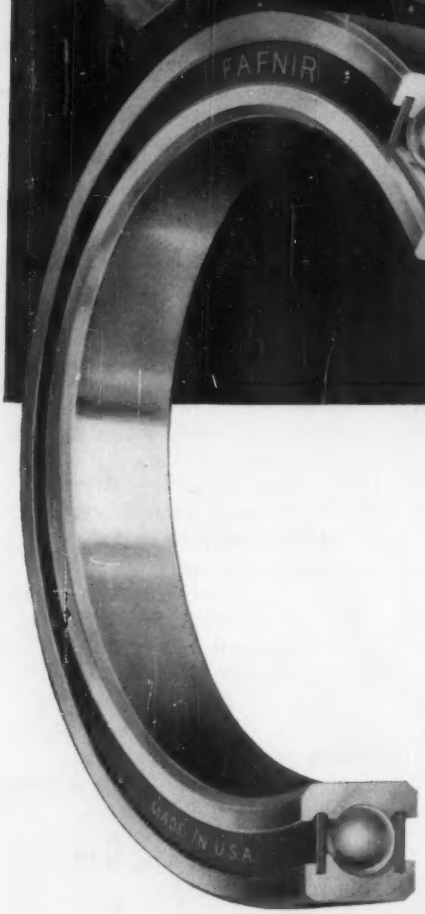

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actions for failures, we have also run normal mission profiles, for both the Redstone and the Atlas launch vehicles, and any abort profiles that it is possible to obtain, so that we could develop an intimate familiarity with these flight profiles. In the process, we have developed flight plans for our actual flights, since we get an exact feeling for the timing of events and know when we have spare time to do something that is not a mandatory part of the operation. Since this trainer was wired in exactly the same manner as the actual flight spacecraft, and since all spacecraft changes were immediately cranked into the trainer, it has also proved a valuable device in trouble-shooting systems design. There have been many cases where a system did not operate exactly as we had envisioned, and we would not have known this fact without having the procedures trainer with which to work. In these cases, we either redesigned the system or modified our procedures to compensate for the changed system.

ALFA Trainer

The next training device we used was the ALFA Trainer, or air lubricated free attitude trainer. A contoured couch was mounted on top of an air bearing, which was essentially frictionless, and with the use of a Mercury hand-controller which actuates compressed-air jets, this trainer could be stabilized and controlled about all three axes. Obviously magnitudes of roll and pitch are limited. At first the trainer was completely open; it has now been completely enclosed so that the Astronaut can only see up through the periscope, which is mounted between his legs. On one wall, a screen has been set up upon which the flight path over the earth is projected and with this device we can practice maintaining attitude control by watching through the periscope and also practice navigation around the earth. In addition, compressed-air retrorockets have been attached to the back of the trainer and allow practice in controlling retrofire under dynamic conditions rather than merely by watching instruments as in the initial procedures trainer. We feel our primary backup mode of retrofire would be with the use of the periscope.

Because one-half of our orbital flight path will be on the dark side of the earth, and because some people feel that stars can be seen even on the bright side, it was felt that some training in astronomy was highly desirable. Therefore, we went to the Moorehead Planetarium at the University of North Carolina and were given basic instructions in the location of the various constellations and stars. When we felt that we were fairly familiar with these basic instructions, a Link trainer with a window the exact size of the Mercury spacecraft was installed within the planetarium and we practiced navigation by the stars as we went through an orbital flight path. Since the field of view is rather limited through the Mercury spacecraft window, this Link trainer provided very valuable exercise. We could run through an orbit in approximately 9 minutes and, therefore, obtained a large amount of training in a short time.

The next group of trainers are the dynamic or stress-type trainers. The first of these are the weightless or zero-g trainers. Since there is no way to simulate weightlessness on the surface of the earth, we flew in aircraft such as the C-131 through a parabolic trajectory. For these simulations we obtained approximately 15 seconds of weightlessness as we flew over the top of the maneuver. We also flew in the back of the KC-135 where we were able to get approximately 30 seconds of weightlessness. The interior of the KC-135 was well padded and we were allowed to move or attempt to move at will in a free zero-g state. At least for limited periods of time, weightlessness was a lot of fun, and we don't anticipate that it will be greatly different for extended periods of time. This condition of free-floating weightlessness has no direct application to flight in the Mercury spacecraft since in the spacecraft we are strapped in a fairly small cockpit. Therefore, we flew in the back seat of F-100s at Edwards Air Force Base, where we could obtain up to 1 minute of zero-g time while strapped in a fighter cockpit. During this time we could eat food, drink water, and so forth. In general, our impressions were that weightlessness, when we were restrained in an aircraft or in the Mercury spacecraft, was essentially the same as any other g-loading encountered during flight. It doesn't really matter whether the g-force is zero or 2 or −2, because the Astronaut is a part of the vehicle anyway.

As a follow-on to this zero-g or weightlessness training, we went into the centrifuge training or high-g training at the Johnsville human centrifuge. A gondola is mounted on the end of a large revolving arm. Within the gondola we installed a mock-up of our total instrument panel with active flight instruments, driven by the centrifuge computer and our Mercury hand controller, and also a complete environmental control system from the Mercury spacecraft. The gondola was then sealed so that we could depressurize the gondola to the actual flight pressure of 5 pounds per square inch. In this way, we could simulate flying at 27,000 feet with 5 pounds per square inch, 100 per cent oxygen atmosphere, and we could note the effects, if any, of applying high-g under reduced pressure.

In general, we found no ill effects. We made simulated flights with and without the pressure suit inflated and were able to run through all Atlas and Mercury normal launch profiles and re-entry profiles, as well as most of the possible Atlas abort re-entry profiles. These abort profiles can call for accelerations as high as 21g but we did not go quite to this level. Some of the Astronauts underwent accelerations of 18g with no excessive difficulty. The primary advantage of the centrifuge was to give us some practice in straining techniques in order to retain good vision and consciousness under high-g loadings and also to develop techniques for breathing and speaking under high-g loads. We also gained practice in controlling the vehicle through the g-load range during the re-entry, essentially a rate-damping maneuver. We were also able to tumble the gondola, to go rapidly from a fairly high positive g to a negative g. This tumbling was an attempt to simulate some of our aborts, primarily at maximum dynamic pressure where the accelerations would go from 10g to −10g in approximately 1 second. We feel the centrifuge has been one of our most valuable training devices.

Another dynamic training device was the MASTIF or multiaxis spin test inertia facility at Lewis Laboratory in Cleveland,

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Ohio. For this device, a seat was mounted within a gimballed frame. A Mercury control handle actuated compressed-nitrogen jets, and Mercury flight instruments were onboard. From an external control station, high-powered nitrogen jets could be actuated which would revolve the device up to 30 rpm. about all three axes simultaneously. Our task was then to take over control with the hand controller and, with the use of our flight instruments, attempt to bring the rates back to zero and establish our original attitude. We experienced no difficulty as far as the control task was concerned. However, the multiaxis spin test did prove to be a somewhat nauseating exercise after a few runs. This training represents one case of training under extreme conditions which we do not anticipate encountering.

The two main cases where we could enter into a tumble-type maneuver would be coming off the booster without any control system operational or having a control jet jam in the open position. In either case, it is anticipated that we could stop tumbling before rates reached any significant magnitude.

We also took an orientation ride in the Revolving Room at Pensacola, Fla. This room rotates at approximately 10 rpm. in an attempt to simulate proposals for rotating a large space ship to induce a small g-field artificially, with the assumption that weightlessness becomes a major problem. The object of the room is to show the Coriolis effects present, which are not too apparent until movement is attempted. This rotating room is again a somewhat nauseating experience to many people.

Since the heats of re-entry initially were assumed to be of a fairly high magnitude, we dressed in ventilated pressure suits and climbed into a steel box. The interior of this box was heated up to approximately 250F by radiating heat from quartz lamps through the walls. We found that these temperatures were no great problem at all, and since the time this program was run, we have discovered that our interior cabin heat load during an actual Atlas re-entry is considerably lower. We no longer have any qualms about the high heat loads involved.

We also took a ride in the carbon-dioxide chamber at Bethesda, Md. We climbed into the chamber; it was sealed; and the carbon-dioxide content was gradually increased from a normal 0.05 per cent to approximately 4 per cent over a period of 3 hours. We were able to note the physiological effects such as increased breathing, pulse rate, flushing, and in some cases, a slight headache. We feel that this carbon-dioxide chamber was a valuable part of our training, since no one has been able to devise a completely satisfactory partial-pressure measuring device, at least for measuring small partial pressures. Therefore, we feel that our best indication of excessive carbon-dioxide onboard the capsule will be our own sensations.

Another very valuable part of our training has been the flying of high-performance aircraft. Mainly, we flew two F-102A airplanes which we have now converted to two F-106A airplanes. Since we were all brought into this program as highly qualified jet pilots, and since this was one reason we were selected to be Astronauts, we felt that it was highly desirable to maintain this proficiency. Ground simulators and trainers are very valuable for practicing procedures. However, the only penalty for erring in a simulator is to shut down the procedure and start over. We feel that by staying highly proficient as pilots of conventional aircraft, we can maintain our sharpness in making rapid judgments and in reacting accordingly, under somewhat adverse conditions where the penalty for erring is greater than merely shutting down a machine and starting over again.

Another part of our training has been the athletic program. Basically, the athletics have been an individual responsibility. Some of us play hand ball, some run, some swim, and if we feel like doing absolutely nothing, that is our prerogative. We have found that being as competitive as we are, the inducement of keeping up with our fellow troops is adequate to keep most of us working away at maintaining good physical condition. The only organized athletics in which we have engaged has been some Scuba diving with the Underwater Demolition Team at Little Creek. Here, we eventually became proficient enough to swim a mile underwater fairly easily. We also obtained some additional benefits because of the similarity of underwater swimming to the condition of weightlessness, especially in murky water such as the Chesapeake Bay. Of course, we also developed practice in breathing with an artificial system under pressurized conditions. We also felt that any increase in familiarity with a water environment was desirable since our primary recovery area is in the water.

Egress and Survival Training

Another major section of our training is the egress and survival training. As previously mentioned, our primary recovery area is in the water and, therefore, all of our practice in egressing has been in the water. Initially, we put our egress trainer in a hydrodynamics tank at Langley Research Center and practiced egressing first in smooth water and then in artificially generated waves. When we felt that we had developed a reasonable amount of proficiency in that facility, we took the trainer down to the Gulf of Mexico, near Pensacola, Fla. We took the egress trainer out to sea on a barge, dropped it over the side, and practiced egressing in the open sea, which was quite rough on numerous occasions. Our primary exit for egress is through the small end of the Mercury spacecraft. The Astronaut has the option of dropping out directly into the water and then inflating his raft, or inflating it first and egressing into the raft. This is a method of egress which would be used if the Astronaut decided to get out of the spacecraft before the arrival of the recovery forces.

Another method of egressing was practiced, where it is assumed the helicopters are in the recovery area at the time of impact. The helicopter hooks on the spacecraft and lifts it partially out of the water so that the lower frame of the door is above the water line. The Astronaut then ejects the hatch and climbs out of the spacecraft. The personnel lifting line or "horse collar," as we call it, is then lowered to the Astronaut and, theoretically, he climbs into this and is lifted onboard the helicopter. Our first attempt at the exercise was obviously not too smooth and is another indication

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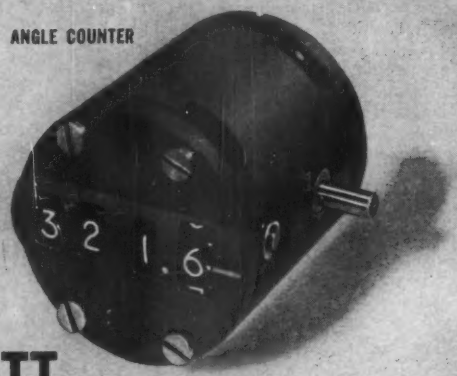

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TYPE	PART NUMBER	NO. OF DIGITS	MAXIMUM COUNT	COUNTS PER REV.	MAXIMUM SPEED RPM	MAXIMUM BREAK AWAY TORQUE @ 20°C
B422 SERIES:[1]						
ANGLE	B422-□[2]	5	179° 59′	20′	1200	.75
(center scale)	C160432-□	5	179° 59′	20′	1200	.75
	C160431-□	6	179° 59.9′	2′	1200	1.0
	C160435-□	4	179.9°	2°	1200	.75
DECIMAL	C160433-□	3	99.9	2.0	1200	.75
(center scale)	C160434-□	4	999.9	2.0	1200	.75
MK II	MK 2 MOD 1	4	359.9	2.0°	1800	.35
Mod I	MK 3 MOD 1	3	359.	2.0°	1800	.35
SERIES:	C1604070043	4	359.9	2.0°	1800	.35
	A403-20B	4	359.9	2.0°	1800	.35

[1] Available in left or right Shaft, End or Side Mount, Mask readout of N-S, E-W, (+), (−)

[2] Same as C160432-□ except .040 shorter length (C160432 preferred for new designs)

[3] Available in various shaft extensions and white or bare aluminum numerals

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of why we need training in these things. Astronaut Shepard used this method of exit on his particular flight without, of course, dropping into the water first. He entered the helicopter completely dry. The advantage of this method of egress is that it is the most rapid way out of the spacecraft and puts the Astronaut onboard the recovery helicopter in minimum time. Also, since a helicopter dropped a spacecraft en route to the recovery area during one early recovery exercise, we haven't had ultimate confidence in riding in the spacecraft while being carried by the helicopter.

The last method of egress is the underwater one. This method would be used, for example, if the spacecraft developed a leak rate after impact of such a magnitude that the Astronaut had insufficient time to get out through the small end. In this case, the Astronaut would have to blow off the side hatch. Once the hatch is off, the capsule rapidly fills with water, and the Astronaut cannot get out until it is completely filled and, hence, sinking. We have found that we can get out under these conditions in around 10 seconds, at which time the small end of the spacecraft is barely under water.

In conjunction with our water egress training, we conducted some water survival training. We spent approximately ½ day in one-man rafts learning how to distill water, protect ourselves from the sun, and signal the rescue forces. This exercise convinced us that we could survive for a great number of days if forced to re-enter in an unspecified recovery area and await recovery for extended periods of time.

We also spent 3 days learning desert survival techniques at Stead Air Force Base, near Reno, Nev. Here again, we learned how to protect ourselves from the sun, how to utilize the limited water supply, and to build clothing and shelter from our parachutes. There is a remote possibility that we could impact in the west African desert, should our orbital insertion be somewhat under speed and our retrorockets not have adequate thrust. This possibility is very remote, but it is an indication of our attempt to train for any possibility, no matter how remote.

Specific Mission Preparation

We have specific mission preparation which prepares us for an individual spacecraft and an individual launch vehicle. This training covers a period of time of approximately 8 weeks during which the spacecraft is at Cape Canaveral undergoing hangar and pad checkouts. The first object of this training is orientation to the specific spacecraft configurations. Even though all the spacecraft are built to a specific set of drawings and specifications, each is an individual and has peculiarities which are not the same in the others. In order for the Astronaut to become intimately familiar with his particular spacecraft, he participates in all the hangar checkouts on it. He participates in reaction control system checks where he can develop a good feel for his particular control system. This participation is also where we get our primary environmental control system training. The Astronaut rides in the spacecraft when it is put in the pressure chamber for pressure checks, and he operates the environmental control system in conjunction with this checkout. He also attends all meetings concerned with

the checkout and modification of the spacecraft, so he is probably the one person most familiar with all details of the spacecraft.

In addition to maintaining a familiarity with the hardware, each Astronaut must practice his specific mission flight plan since each mission is somewhat different. He does this in the procedures trainer, where he runs time and time again over the flight plan which has been laid down for his particular mission. He also runs through all emergencies that anybody can envision happening. During this time, Astronaut performance data is procured for comparison with flight-test result after the flight.

In addition to the pure Astronaut training flights, each Astronaut also practices with the Mercury Control Center flight controllers and the down-range stations involved in his particular flight. The procedures trainer is tied into the Mercury Control Center, and simulated missions are flown while various emergencies are simulated primarily to test the flight controllers. In the process of these exercises, ground rules and mission rules are evolved which apply to this particular mission.

Once the spacecraft is moved to the pad and mated with the booster, the Astronaut then participates in all practice countdowns, radio-frequency compatibility checks, simulated flight tests, and so forth. Detailed launch procedures are developed with the pad crew. Astronaut ingress training is also obtained at this time. In addition, the emergency pad rescue crew is also exercised and techniques are developed for rescuing the Astronaut on the pad should some emergency develop prior to the launch. These are also full-scale training programs, with all personnel involved participating. During this latter period of training the Astronaut is also concentrating on maintaining himself in the best of physical condition. Medical personnel are continuously monitoring his health and insuring that he stays healthy during this period. Part of this program involves placing the Astronaut on a special low-residue diet and collecting specimens for comparison with post-flight specimens.

SHEPARD REPORT

Astronaut D. K. Slayton described the program followed by the Project Mercury Astronauts during a two-year training period with descriptions of the various devices used. All of these devices provided one thing in common; namely, the feeling of confidence that the Astronauts achieved from their use. Some devices, of course, produced more confidence than others but all were very well received by the group. There are three machines or training devices which provided the most assistance. The first of these is the human centrifuge. We used the facilities of the U. S. Naval Air Development Center at Johnsville, Pa., which provide the centrifuge itself and a computer to control its inputs. This computer, through an instrument display, provided a control task similar to that of the Mercury spacecraft, with inputs of the proper aerodynamic and moment-of-inertia equations. Thus, we were able to experience the acceleration environment while simultaneously controlling the spacecraft on a simulated manual system. This experience gave us the feeling of muscle control for circulation and breathing, transmitting, and general control of the spacecraft. I found

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SPECIFICATIONS

Typical Part Numbers	Size	Function	Excitation	Accuracy
325720 325721	8	Resolver	2V 400 cps	15 min.
(Diameter .750". Length 1.250". See 3Z6390-001 below)				
3Z6390-001	25	Resolver Transmitter	20V 900 cps	3 min.
(Ring housing—special hub designed to operate concentrically around a smaller unit.)				
CZ06360-002	As req'd.	Resolver Transmitter	115V 800 cps	20 sec.
(Pancake configuration beryllium housing 5.375" dia. X 1.437" high.)				
5Z6360-009	As req'd.	Resolver	115V 800 cps	3 min. or 5 min.
(Flat aluminum housing conforms to BuOrd 1980052-MIL-R-21530.)				
209981 209984	23	Resolver	As required	10 min.
(High accuracy machined stack allows direct mounting without housing.)				
3Z6210-006	25	Synchro	As required	2 min.
(Various hub and housing configurations available.)				
1/3Z6360-006	As req'd.	Resolver	115V 800 cps	20 sec.
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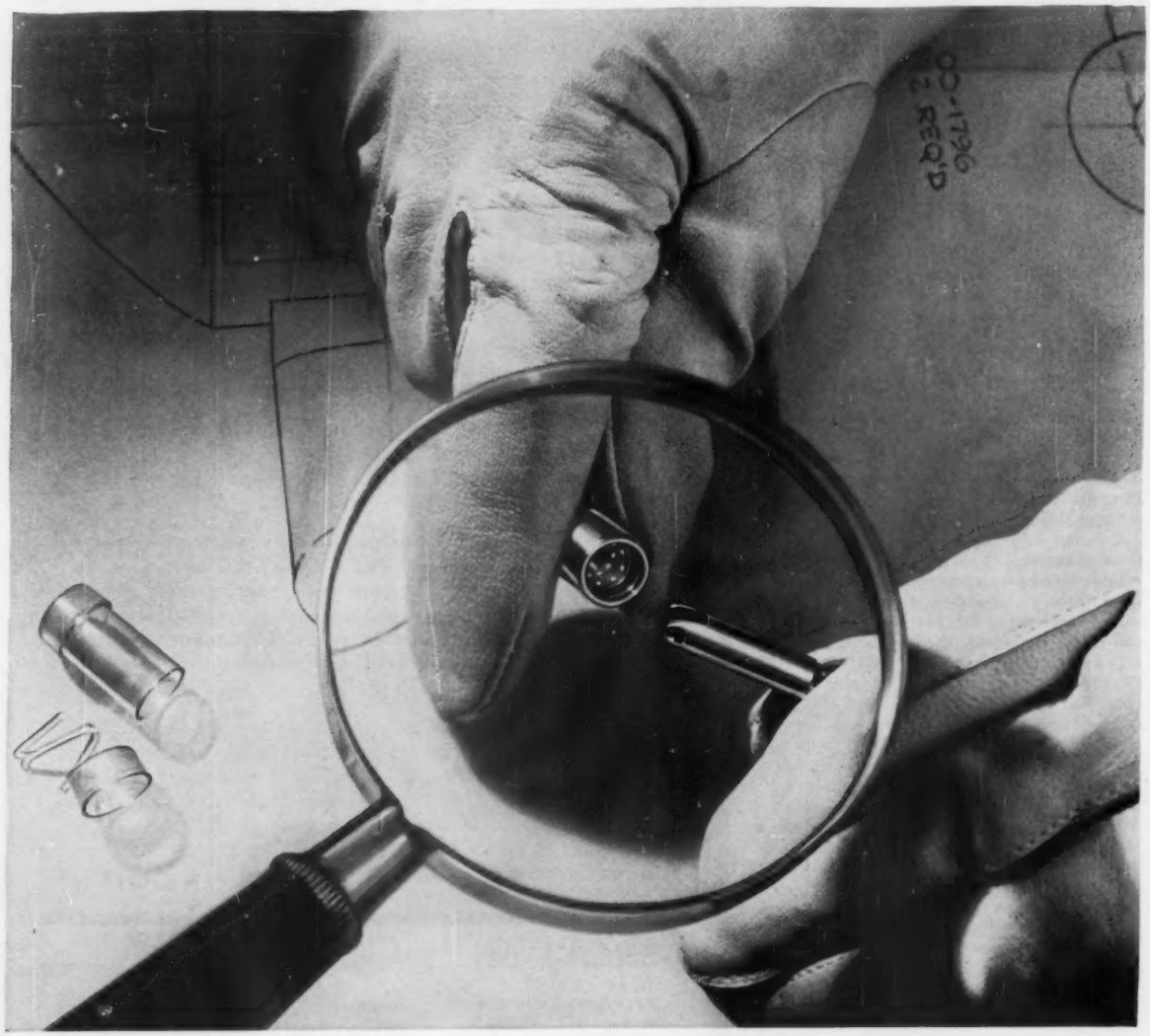

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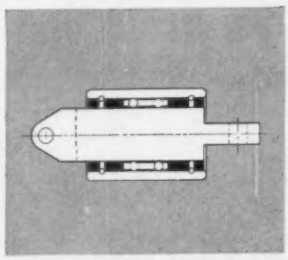

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that the flight environment was very close to the environment provided by the centrifuge. The flight accelerations were smooth, of the same magnitude used during training, and certainly in no way disturbing.

The second training device that proved of great value was the procedures trainer. This device will be recognized as an advanced type of the Link trainer, which was used for instrument training during the last war. We were able to use it to correlate preflight planning, to practice simulated control maneuvers, and to practice operational techniques. The Space Task Group has two such trainers, one at Langley Field, Va., the other at Cape Canaveral, Fla., and both are capable of the simultaneous training of pilots and ground crews. As a result of the cross-training between pilots and the ground crews at the Project Mercury Control Center, we experienced no major difficulties during the flight. We had learned each others' problems and terminology, and I feel that we have a valuable training system in use for present and for future flights.

The third area of preflight training, which is considered as one of importance, concerns working with the spacecraft itself. The Mercury spacecraft is tested at Cape Canaveral before being attached to the Redstone launch vehicle. These tests provide an excellent opportunity for pilots to learn the idiosyncrasies of the various systems. After the spacecraft has been placed on the launch vehicle, more tests are made just prior to launch day. The pilots have a chance to participate in these tests and to work-out operational procedures with the blockhouse crew.

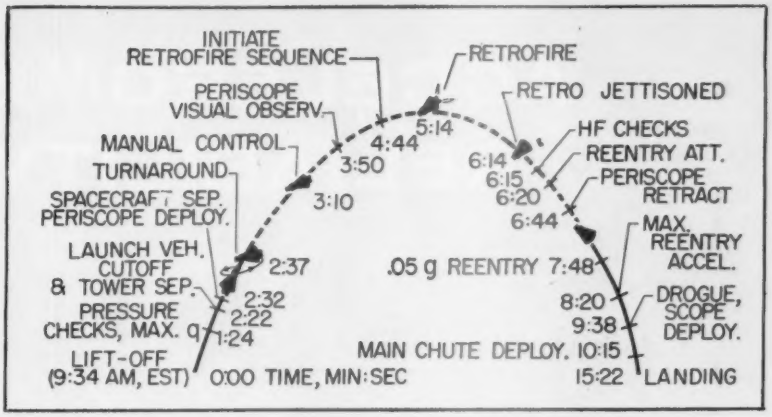
Most Valuable Aids

These three areas then, the centrifuge, the procedures trainer, and spacecraft testing at the launching area, provided the most valuable aids during the training period. We spent two years in training, doing many things, following many avenues in our desire to be sure that we had not overlooked anything of importance. As a general comment concerning future training programs, these experiences will undoubtedly permit us to shorten this training period.

During the days immediately preceding the launch, the preflight physicals were given. These examinations do not involve more than the usual probing, listening, and other medical tests, but I hope that fewer body fluid samples are required in the future. I felt as though an unusual number of needles were used.

Preflight briefing was held at 11:00 a.m. on the day before launch to correlate all operational elements. This briefing was helpful since it gave us a chance to look at weather, radar, camera, and recovery force status. We also had the opportunity to review the control procedures to be used during flight emergencies as well as any late inputs of an operational nature. This briefing was extremely valuable to me in correlating all of the details at the last minute.

I include as part of the flight period the time from insertion into the spacecraft on the launching pad until the time of recovery by the helicopter. The voice and operational procedures developed during the weeks preceding the launch were essentially sound. The countdown went smoothly and no major difficulties were encountered with the ground crews, the control-center crew, and the pilot. There has been some comment in the press about the length of time spent in the spacecraft prior to launch, some 4 hours and 15 minutes to be exact. This period was about two hours longer than had been planned. A fact that is most encouraging is that during this time there was no significant change in pilot alertness and ability. The reassurance gained from this experience applies directly to our upcoming orbital flights, and we now approach them with greater confidence in the ability of the pilots, as well as in the environmental control systems.



TIME SEQUENCE of Cdr. Alan B. Shepard's MR-3 flight (AW May 15, p. 31).

Our plan was for the pilot to report to the blockhouse crew primarily prior to T — 2 minutes on hard wire circuits, and to shift control to the Center by use of radio frequencies at T — 2 minutes. [The symbol T refers to lift-off time.] This shift worked smoothly and continuity of information to the pilot was good. At lift-off I started a clock-timer in the spacecraft and prepared for noise and vibration. I felt none of any serious consequence. The cockpit section experienced no vibration and I did not even have to turn up my radio receiver to full volume to hear the radio transmissions. Radio communication was verified after lift-off, and then periodic transmissions were made at 30-second intervals for the purpose of maintaining voice contact and of reporting vital information to the ground.

Some roughness was expected during the period of transonic flight and of maximum dynamic pressure. These events occurred very close together on the flight, and there was general vibration associated with them. At one point my head vibration was such that my vision was blurred for a few seconds. We intend to avoid a recurrence of this experience by providing more foam rubber for the head support and a more streamlined fairing for the spacecraft adapter ring. These modifications should take care of this problem for future flights.

I had no other difficulty during powered flight. The training in acceleration on the centrifuge was valid, and I encountered no problem in respiration, observation, and reporting to the ground.

Rocket cutoff occurred at T + 2 minutes 22 seconds at an acceleration of about 6g. It was not abrupt enough to give me any problem and I was not aware of any uncomfortable sensation. I had one switch movement at this point which I made on schedule. Ten seconds later, the spacecraft separated from the launch vehicle, and I was aware of the noise of the separation rockets firing. In another 5 seconds the periscope had extended and the autopilot was controlling the turnaround to orbit attitude. Even though this test was only a ballistic flight, most of the spacecraft action and piloting techniques were executed with orbital flight in mind. I would like to make the point again that attitude control in space differs from that in conventional aircraft. There is a penalty for excessive use of the peroxide fuel and we do not attempt to control continually all small rate motions. There is no aerodynamic damping in space to prevent attitude deviation, but neither is is there any flight-path excursion or acceleration purely as a function of variation in spacecraft angles.

At this point in the flight I was scheduled to take control of the attitude [angular position] by use of the manual system. I made this manipulation one axis at a time, switching to pitch, yaw, and roll in that order until I had full control of the craft. I used the instruments first and then the periscope as reference controls. The reaction of the spacecraft was very much like that obtained in the air-bearing trainer [ALFA Trainer] described previously by Astronaut Slayton. The spacecraft movement was smooth and could be controlled precisely. Just prior to retrofiring I used the periscope for general observation.

Camera Orientation

The particular camera orientation during my flight happened to include many clouds. . . . Photographs show the contrast between land and water masses, the cloud cover and its effect, and a good view of the horizon. There appears to be a haze layer at the horizon. This haze is a function not only of particles of dust, moisture, and so forth, but also of light refraction through atmospheric layers. The sky itself is a very deep blue, almost black, because of the absolute lack of light-reflecting particles. We are encouraged that the periscope provides a good viewing device as well as a backup attitude-control indicator and navigation aid.

At about this point, as I have indicated publicly before, I realized that somebody would ask me about weightlessness. I use this example again because it is typical of the lack of anything upsetting during a weightless or zero-g environment. Movements, speech, and breathing are unimpaired and the entire sensation is most analogous

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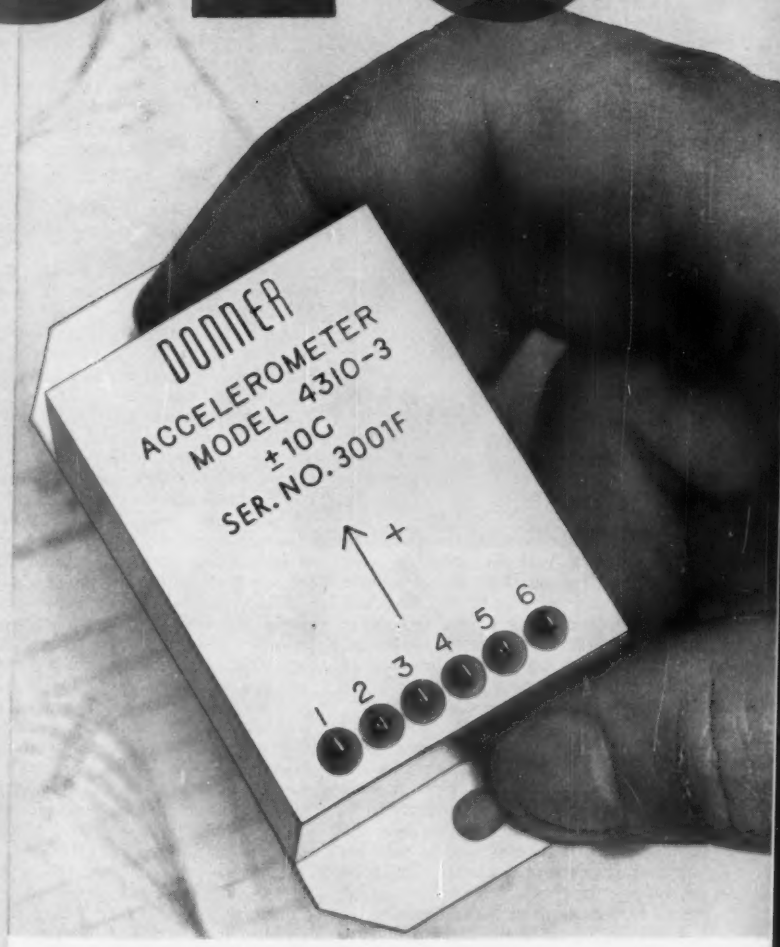

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to floating. NASA intends, of course, to investigate this phenomenon during longer periods of time, but the Astronauts approach these periods with no trepidation.

Control of attitude during retrofiring was maintained on the manual system and was within the limits expected. There was smooth transition from zero gravity to the thrust of the retrorocket and back to weightless flying again. After the retrorockets had been fired, the automatic sequence acted to jettison them. I could hear the noise and could see one of the straps falling away in view of the periscope. My signal light inside did not show proper indication so I used the manual backup control and the function indicated proper operation.

Retrorockets Jettisoned

After retrorockets were jettisoned, I used a combination of manual and electrical control to put the spacecraft in the re-entry attitude. I then went back to autopilot control to allow myself freedom for some other actions. The autopilot control functioned properly so I made checks on the high-frequency voice link for propagation characteristics and then returned to the primary UHF voice link. I also looked out both portholes to get a general look at the stars or planets as well as to get oblique horizon views. Because of sun angle and light levels I was unable to see any celestial bodies. The Mercury project plans are to investigate these phenomena further on later flights.

At an altitude of about 200,000 feet, or at the edge of the sensible atmosphere, a relay was actuated at 0.05g. I had intended to be on manual control for this portion of the flight but found myself a few seconds behind. I was able to switch to the manual system and make some controlling motions during this time. We feel that programing for this maneuver is not a serious problem and can be corrected by allowing a little more time to the maneuver to get ready. We were anxious to get our money's worth out of the flight and consequently we had a full flight plan. However, it paid off in most cases, as evidenced by the volume of data collected on pilot actions.

The re-entry and its attendant acceleration pulse of 11g was not unduly difficult. The functions of observation, motion, and reporting were maintained, and no respiration difficulties were encountered. Here again, the centrifuge training had provided good reference. I noticed no loss of peripheral vision, which is the first indication of "gray-out."

After the acceleration pulse I switched back to the autopilot. I got ready to observe parachute opening. At 21,000 feet the drogue parachute came out on schedule as did the periscope. I could see the drogue and its action through the periscope. There was no abrupt motion at drogue deployment. At 10,000 feet the main parachute came out and I was able to observe the entire operation through the periscope. I could see the streaming action as well as the unreefing action and could immediately assess the condition of the canopy. It looked good and the opening shock was smooth and welcome. I reported all of these events to the control center and then proceeded to get ready for landing.

I opened the faceplate of the helmet and disconnected the hose which supplies oxygen to its seal. I removed the chest strap and the knee restraint straps. I had the lap belt and shoulder harness still fastened. The landing did not seem any more severe than a catapult shot from an aircraft carrier. The spacecraft hit and then flopped on its side so that I was on my right side. I felt that I could immediately execute an underwater escape should it become necessary. Here again, our training was giving us dividends. I could see the water covering one porthole, I could see the yellow dye marker out the other porthole, and later on, I could see one of the helicopters through the periscope.

The capsule righted itself slowly and I began to read the cockpit instruments for data purposes after impact. I found very little time for that since the helicopter was already calling me. I made an egress as shown in the training movie; that is, I sat on the edge of the door sill until the helicopter sling came my way. The hoist itself was uneventful. At this point, I would like to mention a device that we use on our pressure suits that gives watertight integrity. There is a soft rubber cone attached to the neck ring seal of the suit. When the suit helmet is on, this rubber is rolled and stowed away below the lip of the neck ring seal bearing. With the helmet off, this collar or neck cone is rolled up over the bearing and against the neck of the pilot where it forms a watertight seal. The inlet valve fitting has a locking flapper valve. Thus the suit is waterproof and provides its own buoyancy.

Postflight Debriefing

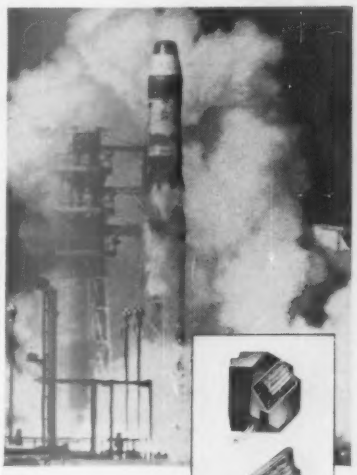
The helicopter took me to the aircraft carrier Lake Champlain, where the preliminary medical and technical debriefing commenced. Since no serious physiological defects were noted, only an immediate cursory examination was necessary. The period I spent in talking into a tape recorder at this time with the events fresh in my mind was also a help. I had a chance to report before becoming confused with the "facts."

I went from the carrier to Grand Bahama Island where I spent the better part of two days in combined medical and technical debriefings. A great deal of data was gathered, and the experience was not unduly uncomfortable. It appears profitable to provide a location where a debriefing of this sort can be accomplished.

A film of the flight has been taken from the onboard camera and step-printed to real time, and the tape recorder conversations have been synchronized for the entire flight. These two recording mediums were not flight synchronized since there was no requirement for this in data gathering, but they have been ingeniously joined.

In closing I would like to say that the participants in Project Mercury are indeed encouraged by the pilot's abilities to function during the ballistic flight which has just been described. No inordinate physiological change has been observed, and the control exercised before and after the flight overwhelmingly supports this conclusion. The Space Task Group is also encouraged by the operation of the spacecraft systems in the automatic mode, as well as in the manual mode. We are looking forward to more flights in the future, both of the ballistic as well as the orbital type.

Solution to critical temperature control problem on TITAN guidance platform



form-fitting control boxes fit small irregular space . . . temperature held to within a few hundredths of one degree

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Assignment to Barber-Colman Company from Air Force TITAN associate contractor, AC Spark Plug, Milwaukee: Take one part of the Air Force TITAN guidance platform and develop a complete temperature control system that will fit into the odd-shaped, very limited space available. Hold temperature to the exceptionally close tolerances specified. *Result:* A precision Barber-Colman temperature control system incorporating an ingeniously formed set of compact control boxes and sensing element (right) which control temperature of the internal structure to within a few hundredths of one degree. For help with your temperature control problems consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Dayton, Fort Worth, Los Angeles, Montreal, New York, Rockford, San Diego, Seattle, Winter Park, Florida.

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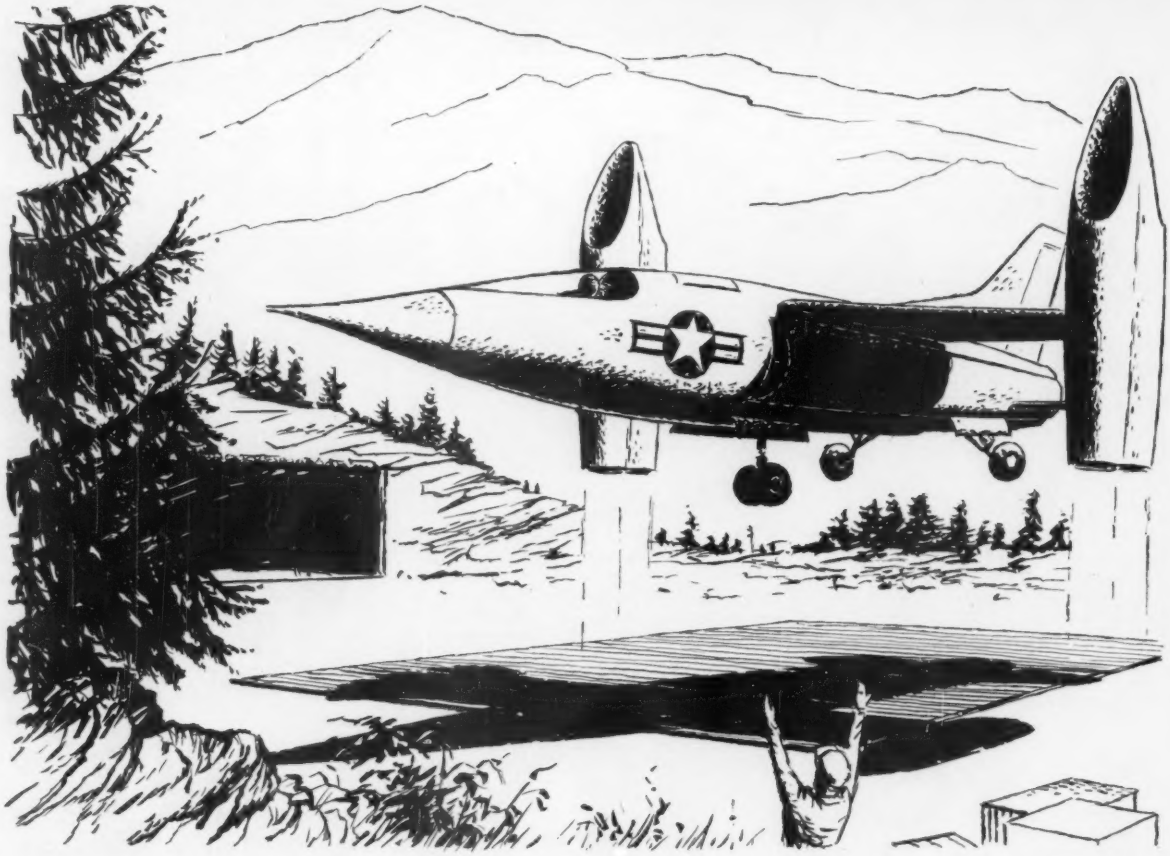

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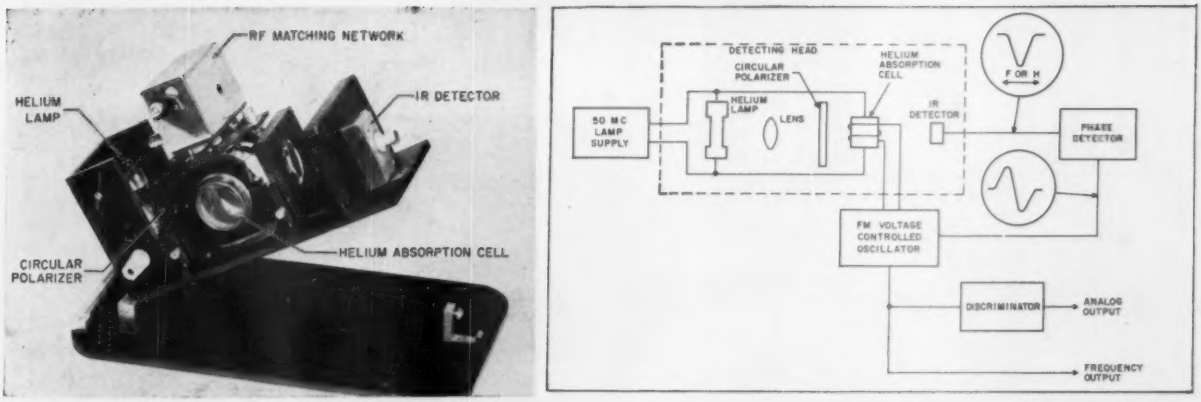


HELIUM MAGNETOMETER, with sensitivity of one part in five million, can operate over wide temperature range and is relatively insensitive to orientation. Device was developed by Texas Instruments. Unit shown above is laboratory model. New type magnetometer employs helium absorption cell whose atoms absorb maximum energy from infrared beam when FM oscillator is tuned to resonant frequency at which time its frequency is proportional to magnetic field strength.

Sensitive Magnetometer Has Space Role

By Philip J. Klass

New type of magnetometer, with a sensitivity of one part in five million and other characteristics which make it attractive for measuring magnetic fields in space, for submarine detection and for geophysical prospecting, is now being tested by several government/military agencies.

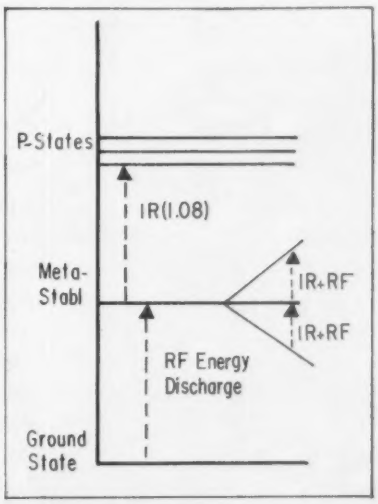
The performance of the device, known as a metastable helium magnetometer, is essentially independent of its ambient temperature over a wide temperature range, from near absolute zero to 200C, according to Texas Instruments which developed the device. The helium magnetometer was invented by Dr. Peter Franken of the University of Michigan. Texas Instruments has carried on its development with company funds.

The new type magnetometer can measure magnetic field strength with an error of less than 10^{-11} gauss per degree of sensor axis displacement from the direction of the field, according to Texas Instruments' Dr. Bernard List. Another feature, which is important for use in space vehicles that employ spin stabilization, is that the magnetometer's accuracy is affected far less by angular rotation than previous types, according to List.

A complete airborne helium magnetometer, which Texas Instruments has proposed to an undisclosed military agency, is expected to weigh about 50 lb. A transistorized model intended for a less rigorous ground environment could be built weighing about 20 lb., a company spokesman estimates.

One present limitation of the helium magnetometer, compared with the competitive rubidium magnetometer, is for the measurement of extremely weak magnetic fields in space where the latter has greater sensitivity by a factor of perhaps 10:1, a Texas Instruments spokesman concedes.

The new helium magnetometer employs many of the basic principles used in maser and optical maser (laser) devices. Optical pumping and optical detection at infrared wavelengths are employed to detect the magnetic resonance of helium atoms, which is directly proportional to the strength of the magnetic field to which the helium atoms are exposed.



ENERGY LEVEL diagram illustrates operation of new magnetometer. Fixed frequency RF source raises atoms to metastable state where they absorb infrared energy and rise to P-state, then returning to metastable state while radiating infrared in all directions. Additional infrared energy is absorbed when atoms are excited by RF field, tuned to resonant frequency proportional to magnetic field strength, which raises atoms to different energy levels at the metastable state.

The helium atoms, contained in a sealed device known as an absorption cell, are excited by means of an electrical discharge produced by radio frequency energy. The absorption cell and its helium atoms also are exposed to a radio frequency field whose frequency can be varied over a wide range.

When a beam of infrared light of suitable wavelength (1.08 microns) is focused on the absorption cell from one side, the amount of infrared energy that is absorbed by the helium atoms, and hence the remaining amount which passes through to an infrared detector, depends upon the strength of the magnetic field and the frequency of the RF field to which the atoms in the cell also are exposed.

If the frequency of an RF oscillator is varied until the amount of infrared beam energy absorbed is a maximum, then the frequency of this oscillator will be directly proportional to the strength of the magnetic field to which the absorption cell is exposed. This proportionality factor is 2.8 mc. per gauss. That is, if the RF source frequency is varied until the amount of infrared energy absorbed is a maximum, and the oscillator frequency is 5.6 mc., then the cell is in a magnetic field of two gauss.

In the Texas Instruments magnetometer, the point of maximum infrared absorption is established by means of an infrared detector. When absorption is a maximum, the amount of infrared

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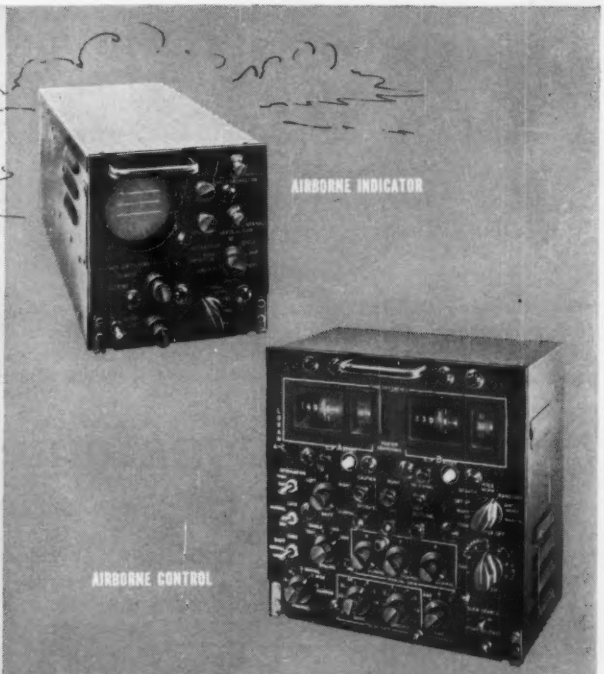

Shipboard

Now in production, Sperry's shipboard automatic direct-reading Loran-C receivers offer the finest and most accurate system of long range marine navigation. Other applications include all those shown for the airborne receivers above, as well as picket ships, underwater cable installation and other specialized tasks. Both the airborne and shipboard systems are ready to go to work with the established and growing Coast Guard network of Loran-C transmitting stations. Both are designed to meet specifications of both Bureau of Naval Weapons and Bureau of Ships.

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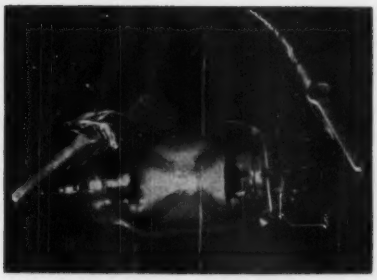


MINIATURE coaxial model of helium magnetometer measures only 1½ in. dia. x 3½ in.

energy passing through the cell to the detector will be at a minimum.

Additionally, the procedure of locating the RF frequency which produces maximum absorption is accomplished automatically by means of a phase detector which controls the oscillator producing the RF field around the cell.

Because the frequency of the oscillator is directly proportional to the magnetic field to which the cell is exposed, field strength can be read out directly in digital form from the oscillator's output. If an analog output is needed, this can be provided by means of a frequency discriminator circuit.

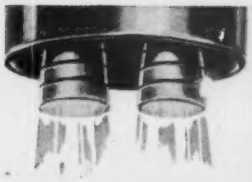
The infrared beam to excite the helium atoms in the absorption cell is obtained from a bright helium lamp, excited from the same fixed frequency source used to produce a discharge in the cell. The frequency of RF energy needed for the lamp is not critical. Present models operate at about 50 mc. The infrared emitted by the helium lamp is focused and collimated by means of a lens and a circular polarizer.

A more detailed explanation of the helium magnetometer's principles of operation involves the helium atom and its several energy states and energy levels within these states. The lowest energy state of the helium atom, called the ground state, is the natural one when there is no external source of excitation for the atoms.

When the helium atoms in the absorption cell are excited by the 50-mc. (fixed frequency) source, the resulting discharge raises a few of the atoms from the ground state to the intermediate metastable state.

There are three energy levels at the metastable state. These are known as: m = −1, m = 0 and m = +1. When the helium atoms move up from the ground state to the metastable state, the largest number will assume the m = −1 energy level, the fewest number will assume the m = +1 level, while the m = 0 will have a figure somewhere between these two extremes. The difference between each two adjoining energy levels corresponds to 2.8 mc. when the helium atoms are exposed to a one-gauss magnetic field.

When the infrared lamp is turned



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on, and its beam is focused on helium atoms in the absorption cell, those which have been raised to the metastable state by the previously mentioned discharge across the cell will absorb infrared energy and be elevated to the highest "P" state, which also has three different energy levels.

But the P-state is a transient one and atoms elevated to this state quickly fall back to the metastable state. In so doing they radiate the infrared photon energy which they earlier had absorbed. But this infrared energy is radiated in all directions so that only a portion of it reaches the infrared detector.

If the helium atoms in the cell are now exposed to an RF field, a useful phenomenon known as the Zeeman Effect occurs. As previously mentioned, the difference among the three energy levels of the metastable state is a function of the magnetic field to which the atoms are exposed. As the oscillator frequency nears the resonant frequency for the particular magnetic field to which the atoms are exposed (2.8 mc. per gauss), atoms at the energy level of $m = +1$ will absorb additional energy from the infrared beam and move up to the energy level $m = 0$, while those atoms at the $m = 0$ level will absorb infrared energy which elevates them to the $m = -1$ energy level.

When the oscillator is tuned to the resonant frequency which corresponds precisely to the magnetic field to which the atoms are exposed, the maximum amount of energy will be absorbed from the infrared beam, and the infrared detector's output will be at a minimum level.

At such time, the oscillator frequency will be directly proportional to the magnetic field which is to be measured.

One currently available model of the new Texas Instruments helium magnetometer sensor, containing the bright helium lamp, circular polarizer, absorption cell and infrared detector, measures 13 x 7 x 7 in. and weighs 6 lb. Another model has been designed in which the sensor occupies a volume of only 4 x 3 x 2 in. A miniaturized version, which measures only 1¼ in. dia. x 3¼ in. long, contains both the helium lamp and absorption cell in a single coaxial package. At present, this miniature magnetometer has a sensitivity of only 0.5 gamma, about 1/50th that of the larger models. (One gamma equals 0.0001 gauss.) However, the company says it believes this sensitivity can be increased.

Texas Instruments has delivered experimental models of its new helium magnetometer to several undisclosed government/military agencies for tests and says it currently is negotiating with others for hardware designed for operational use.

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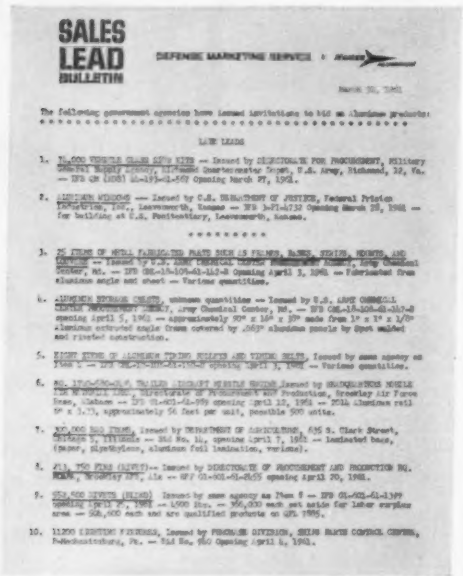

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2. ALUMINUM WINDOWS — Issued by U.S. DEPARTMENT OF JUSTICE, Federal Prison Industries, Inc., Leavenworth, Kansas — IFB 3-FI-4732 Opening March 28, 1961 — for building at U.S. Penitentiary, Leavenworth, Kansas.

* * * * * * * * *

3. 25 ITEMS OF METAL FABRICATED PARTS SUCH AS PLATES, BARS, STRIPS, MOUNTS, AND CHANNELS — Issued by U.S. ARMY CHEMICAL CENTER Edgewood Arsenal Branch, Army Chemical Center, Md. — IFB DAC-18-109-61-142-B Opening April 3, 1961 — Fabricated from aluminum angle and sheet — Various quantities.

4. ALUMINUM STORAGE CASES, minimum quantities — Issued by U.S. ARMY CHEMICAL CENTER Procurement Branch, Army Chemical Center, Md. — IFB CAC-18-109-61-317-B opening April 5, 1961 — Approximately 30" x 16" x 20" made from 1" x 1" x 1/8" aluminum extruded angle frame covered by .063" aluminum panels by Spot welded and riveted construction.

5. EIGHT ITEMS OF ALUMINUM TYING ROLLERS AND TYING BELTS, Issued by same agency as Item 4 — IFB DAC-18-109-61-141-B opening April 3, 1961 — Various quantities.

6. AN-LTV-A-7A-A-2 TRAILER, INFLIGHT MISSILE HANDLING Issued by HEADQUARTERS MOBILE AIR MATERIEL AREA, DEPARTMENT OF PROCUREMENT AND Production, Brookley Air Force Base, Alabama — IFB 61-401-61-999 opening April 12, 1961 — 2024 Aluminum rail 9" x 3.75, approximately 56 feet per unit, possible 500 units.

7. XX,XXX BAG ITEMS, Issued by DEPARTMENT OF AGRICULTURE, 635 S. Clark Street, Chicago 5, Illinois — Bid No. 14, opening April 7, 1961 — Laminated base, (paper, Mylar&Nylon, aluminum foil lamination, various).

8. X-11 VCO FINS (SIXTY)— Issued by DIRECTORATE OF PROCUREMENT AND PRODUCTION DU. MCAL, McConnell AFB, Kan — IFB 61-401-61-8455 opening April 20, 1961.

9. XXX,XXX DIVERS (BRASS) Issued by same agency as Item 8 — IFB 61-401-61-1399 opening April 7, 1961 — 1,000 Min. — 350,000 each set aside for later surplus area — 528,000 each and are qualified products on QPL 1005.

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High-Density Field Telephone Is Tested

Washington—Novel radio-telephone system, which permits any station to call any one of a large number of other stations and carry on a private conversation without significant interference from other users conducting simultaneous conversations, was demonstrated here by Martin's Orlando Division.

The new system, providing VHF/UHF voice and data service, appears to be well-suited for use by a field army whose many mobile radio sets, together with those of enemy forces, may create so much mutual interference as to disrupt vital communications. Martin also sees advantages for air-ground communications.

Martin calls its new system Racep, an acronym for Random Access and Correlation for Extended Performance. From limited details disclosed by the company, it appears to be similar to the "spread-spectrum" broadbank communications techniques which have been under investigation by General Electric, Sylvania, Philco and others. This new technique provides more efficient use of radio spectrum when user duty cycle is low, i.e., when users talk only periodically and/or with frequent pauses in the conversation.

Racep can provide 70 simultaneous voice channels (35 full duplex channels) in a 4-mc. bandwidth if all users talked continuously without pause. This amounts to 57 kc. per channel, or slightly more than the 50 kc. now used in conventional air-ground communications.

Multiple Conversations

However, because of the novel interleaving of conversations without significant interference made possible by Racep, it appears possible to accommodate 700 users in the 4-mc. bandwidth, assuming a use factor (duty cycle) of 10%, according to Martin.

The system is not arbitrarily limited to this, or any other, number. As the number of simultaneous conversations taking place at any instant increases, each user will hear an increasing amount of static-like noise in the background.

If the number of instantaneous users exceeds 700 and/or the use factor exceeds 10%, it merely becomes more difficult for each user to hear the incoming message over the background noise.

For this reason, the system tends to be self-improving. When use increases and background noise grows, individual users will speak more slowly to improve intelligibility, which in itself will reduce the use factor at any instant and reduce noise. Also, users with low-priority messages will tend to become discouraged and hang up, further decreasing background noise.

Racep is expected to operate much like a dial telephone system except that it requires no landlines or central exchange. Each station is assigned a discrete code (address), equivalent to a telephone number. A directory available to the operator lists the three-character codes of each station in the radio network.

Calling Procedure

To call any station in the network, an operator would look up the code of the other and set it into his own transmitter by means of dials or counters. Next, the operator turns a switch to the "monitor" position to determine if the station being called is free or already occupied in conversation.

When the station to be called is free, the operator pushes a button which actuates an audible/visual alarm on the station being called. When the operator at this station picks up his handset, the two can converse as they would via a telephone.

An interesting feature of Racep is an override provision which enables a commander at a key station to instantly reach all other stations in the network, if he so desires, interrupting other conversations that may be in progress. However, this feature could backfire if an enemy learned the override code and built a transmitter to broadcast it, blocking out communications throughout the network.

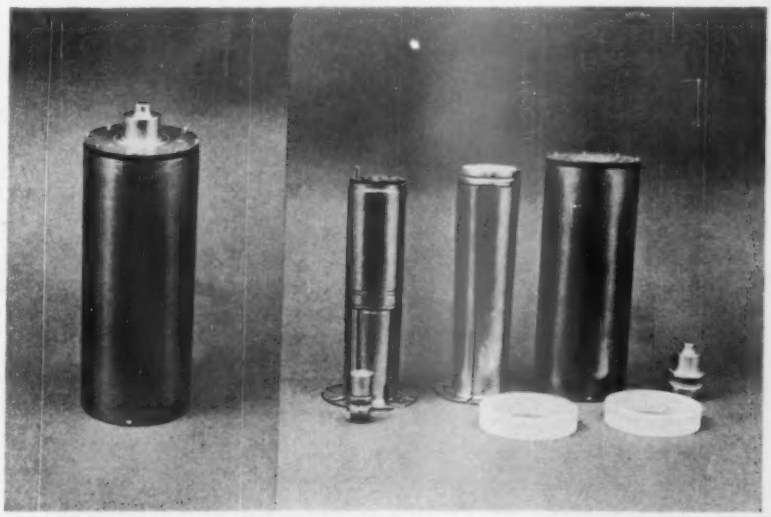
For competitive reasons, and because Martin has not yet been granted patents on what it believes are innovations in Racep, the company does not discuss the principles of system operation.

The speech waveform of the speaker is sampled and converted to a modified form of pulse position modulation (PPM). Each PPM pulse is then address-coded for the intended receiving station (set in earlier by the operator) by transmitting it as a group of "sub-pulses." Individual sub-pulses in any group will be transmitted at different carrier frequencies within the 4-mc. band and with appropriate code time delays between individual pulses.

Time Frequency Matrix

This combination of carrier frequency of each pulse and time-delay between pulses, which Martin calls a "time-frequency matrix", earmarks the message for the intended station. All stations in the area will receive the pulses, but only the intended recipient can decode the pulses and reconstruct them into speech.

At the receiver, each of the sub-pulses in the pulse-group is envelope-detected followed by insertion of complementary delays and coincidence gating, Martin says. All sub-pulses must be present in



Small UHF Satellite Transmitter Displayed

Compact transmitter designed to provide one to two kilowatts of power in the 200- to 400-mc. region of the UHF frequency band during actual missile or spacecraft flight is contained in a cylinder, 13-in. long and 4½ in. in diameter. The outer shell (left) is the power amplifier resonant circuit. Protruding from the top of the cylinder is the power amplifier tube. The disassembled view of the transmitter (right) shows three cylindrical cavities, two tubes and a pair of beryllia spacers which make up the transmitter. Manufacturer: Space Electronics Corp., Glendale, Calif.

FEATHER-WEIGHT

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Here's some hardware that's designed for high-altitude hitch-hiking—so light (the digital read-out unit shown weighs only 1.6 ounces) and so small that they're strictly in the "no problem" category as far as load and air frame space is concerned. And in return for a lift, they give you completely reliable operating time data. There's no better way to turn "down-time" into "air-time" for critical flight systems. Dial as well as digital read-out units are available, AC or DC to suit your circuits, and they surpass the toughest military requirements easily. Write for bulletin today . . . ask for ETi-1.

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the proper time-slots before the full PPM pulse will appear at the output of the decoder. The decoder output is fed to a non-synchronous PPM demodulator which regenerates the original spoken waveform.

The use of pulses which are very narrow relative to the sampling period permits signals from many different transmitters to occupy the same common frequency channel with only a small amount of cross-talk, Martin says. By using non-synchronous PPM and voice-actuated transmission, a random interleaving of many conversations occurs which gives minimum pulse density and minimum cross-talk, according to the company.

Spectrum Saver

If users of a radio network talked continuously, without pause or interruption, Racep would offer little spectrum saving over conventional techniques. But in practice a considerable amount of spectrum goes to waste when specific frequencies are reserved for use by stations which need to communicate only occasionally, with additional waste whenever the operators pause or hesitate in their conversations. Collectively these brief, but frequent, pauses and interruptions add up to considerable spectrum time.

Martin's Racep employs a technique which avoids both types of spectrum waste, allowing communicators to utilize "crumbs of spectrum" which otherwise would be lost.

Martin says it has been working on the Racep technique for several years. The program to date has been funded by the company, but it is now negotiating with several military agencies for procurement of hardware for test evaluation, the company says.

Within six months, Martin expects to have models of mobile Racep transmitter-receiver equipment with peak-power output of 1 kw., capable of providing ranges of about 15 mi. for surface use.

Models demonstrated here were low-power units suitable only for very short-range communications.

Because the technique can be used to provide simultaneous voice and data communications, Martin believes Racep has attractive advantages for air-ground use and has held preliminary discussions with the Federal Aviation Agency.

Another possible application, according to Martin, is for missile guidance where a large number of missiles must be launched nearly simultaneously from the same area. Each missile can receive its own special guidance commands, specifically addressed to its missile-borne receiver. Because Racep is non-synchronous, the danger of capture of "synch" programs or other enemy countermeasures is minimized, the firm says.

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The ever growing demands of space-age computing call for faster and faster collection, transmission and interpretation of data from a large number and variety of sources. Meeting these rigid, real-time requirements is the solid-state Bendix G-20—a powerful communications-oriented computing system of unlimited expandability and flexibility.

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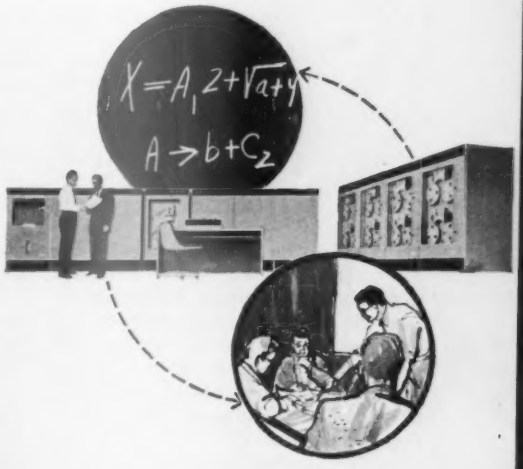

For further information, write:

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FILTER CENTER

▶ **Semiconductor Inductance Investigated** – Naval Research Laboratory scientists, exploring the feasibility of using the inertial inductance of a semiconductor diode to produce a semiconductor inductance, have produced a notch filter with a "Q" greater than 1,000, using a double-base diode in combination with an R-C network. The inertial inductance that occurs in the base region of a forward-biased P-N junction differs from conventional inductance produced by a magnetic field because it appears to be connected invariably with a series and parallel resistance that limits its inherent "Q" to less than one.

▶ **Solar Cell Sorter Developed** – Machine which automatically measures conversion efficiency of silicon solar cells and sorts them out according to efficiency has been developed by Chrysler Corp.'s Missile Division, Huntsville, Ala., for the George C. Marshall Space Flight Center. Device sorts cells at rate of 12 per min. into six efficiency ranges.

▶ **RCA Gets New Mass Spectrograph**–Spark-source mass spectrograph, designed to sort out and identify one impurity atom among more than a billion atoms in only an hour, has been delivered to RCA Laboratories for use in materials research. New instrument, built by Britain's Associated Electrical Industries, Ltd., is one of the world's most sensitive research tools, according to RCA.

▶ **Advanced Satellite Telemetry**–Advanced PCM telemetry system, designed to make PCM more versatile, will be developed by Space Electronics Corp. under a $93,000 six-month contract from National Aeronautics and Space Administration. System is designed to operate over a wide range of data inputs and will have a 10-bit analog-to-digital converter. Important phase of development will center about effort to come up with a small lightweight, low-power analog commutator.

▶ **Semiconductor Network Prices to Fall** –Texas Instruments expects the price curve for its solid circuit semiconductor networks to drop exponentially in the next several years crossing the projected flat curve for conventional components sometime in 1964. Today, equipment made with these integrated circuits costs five times more than the same unit using conventional components, according to estimates by Texas Instruments' engineers (AW June 12, p. 73).

▶ **Joint Semiconductor Film Study**–Battelle Memorial Institute will assist Lear's Solid State Physics Laboratory in an evaluation of diodes and transistors made by Lear's technique of evaporating thin films of single-crystal germanium and other semiconductors on dielectric substrates. Lear has reproducibly evaporated germanium films on dielectric substrates for some time (AW Dec. 5, p. 99), and now Battelle, under a $27,000 contract from Lear, will evaluate the quality of devices which can be made by this technique. If diodes and transistors can be evaporated in this way, it would then be possible to evaporate active as well as passive film components on a single dielectric substrate.

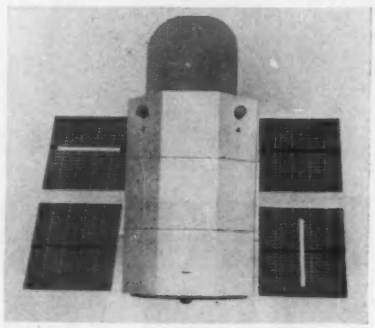
▶ **National Optical Maser Coordination**–James Bridges, director of electronics, Office of Director of Defense Research and Engineering, is attempting to organize a committee within the Department of Defense to coordinate applied research on optical masers. The committee would attempt to encourage research on these new devices, which, Bridges says, may be one of the most significant electronic developments in 20 years.

▶ **Superpower Tube Development**–Klystrons capable of turning out average powers in the megawatt region in X-band are being developed by Varian Associates under a $4-million contract from the Army Signal Corps, which has responsibility for research and development of tubes needed for the Army's Nike Zeus and Zemar programs.

▶ **Continuously Monitored Radar**–Test equipment, known as Narate (Naval Advanced Radar Test Equipment), which will be integrated into the AN/SPS-39A radar aboard the Navy's guided missile cruiser USS Albany was recently delivered to the Naval Electronics Laboratory by Nortronics. The equipment is designed to continuously monitor the radar and to isolate malfunctions down to optimum maintenance level, according to the company. Narate stems from Nortronics' Datico equipment which will be used in Polaris submarines.

▶ **New Bright Film Developed**–Westinghouse Electric has produced extremely thin electroluminescent films, using zinc sulfide, which can produce a brightness of more than 500 foot-lamberts, approximately 10 times the average brightness of a well-lighted room, W. A. Thornton reported during a recent spring meeting of the American Physical Society in Washington. The films, only 1/50th the thickness of a human hair, can produce barely visible light emission when excited by as little as two volts.

ASTRONOMICAL SATELLITE



National Aeronautics and Space Administration's Astronomical Observatory will be launched 500 miles into space in 1963. It will orbit above the screen of Earth's atmosphere, which distorts and absorbs radiation from stellar objects. Observations through a 36 inch telescope from this vantage point will provide astronomical data unavailable from any ground-based equipment.

Initial Stabilization—Within five hours after reaching orbit, the Astronomical Satellite's stabilization and control system will eliminate tumbling and roll, and orient its optical axis away from the sun. Reference to a predetermined star pattern will verify initial stabilization.

Accurate Stabilization—Next, the satellite will be pointed and held to within 1.0 minute of arc, using feedback from the system's six star-trackers. Feedback from experimental optics will then be used to stabilize the satellite within 0.1 seconds of arc.

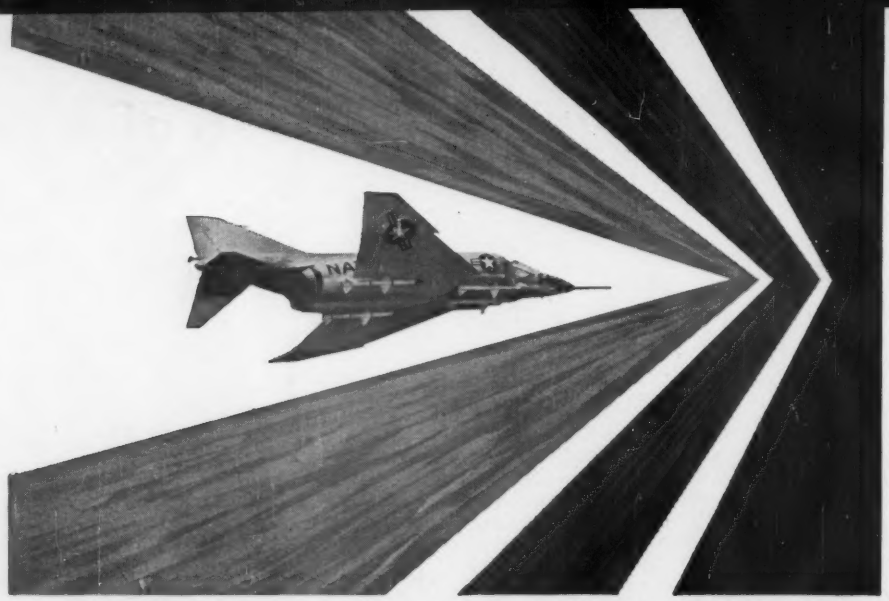
General Electric's Missile and Space Vehicle Department is developing the stabilization and control system for the Astronomical Satellite. Similar systems for Atlas and Thor re-entry vehicles, and Advent and Nimbus satellites have already been designed by MSVD . . . a department of the G.E. Defense Electronics Division. 160-09

GENERAL ELECTRIC

ASTRONOMICAL SATELLITE will orbit beyond Earth's atmospheric haze—historic barrier to man's study of stars. Once this NASA satellite is stabilized in orbit, its ground-controlled telescopic and electronic equipment can automatically observe, collect and transmit data. The control and stabilization system for this orbiting astronomical observatory is being developed by General Electric's Missile and Space Vehicle Department for Grumman Aircraft Engineering Corporation, prime contractor for the Astronomical Satellite.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT, PHILADELPHIA, PA.



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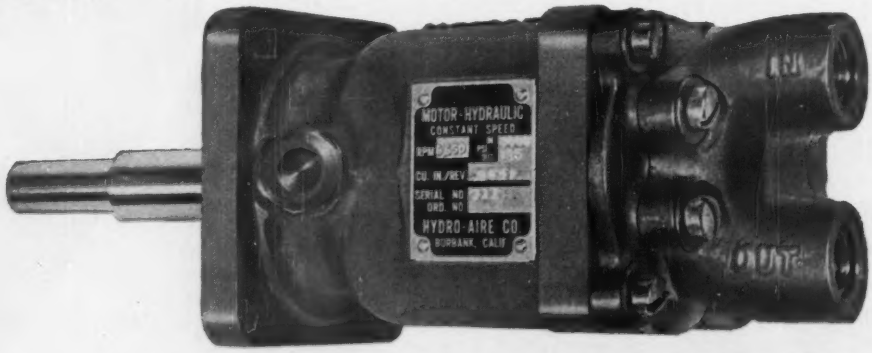

You can bet McDonnell had good reasons to choose Hydro-Aire hydraulic motors for this advanced application. The first is reliability resulting from optimum design simplicity and now proved both in flight and in extensive environmental tests. Others are reflected in the characteristics of this typical model, 68-193-079. Displacement: 0.0787 cu. in. per rev. Torque: 30.4 in. lbs. at 2800 PSI inlet to outlet pressure differential and 12,000 rpm. Hp/Wt. ratio: 3.92:1. Life: 1200 hours. Write now for data sheets on available models and/or a prompt quote on your specifications.

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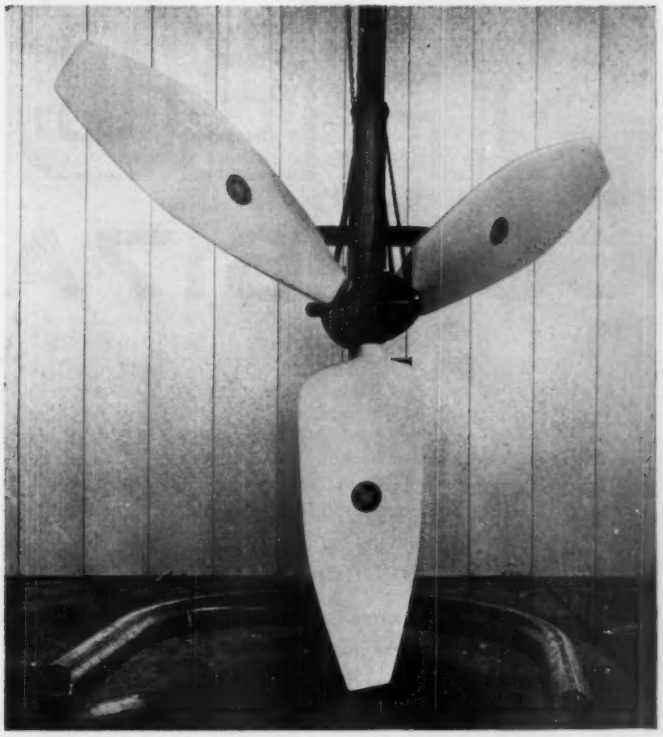
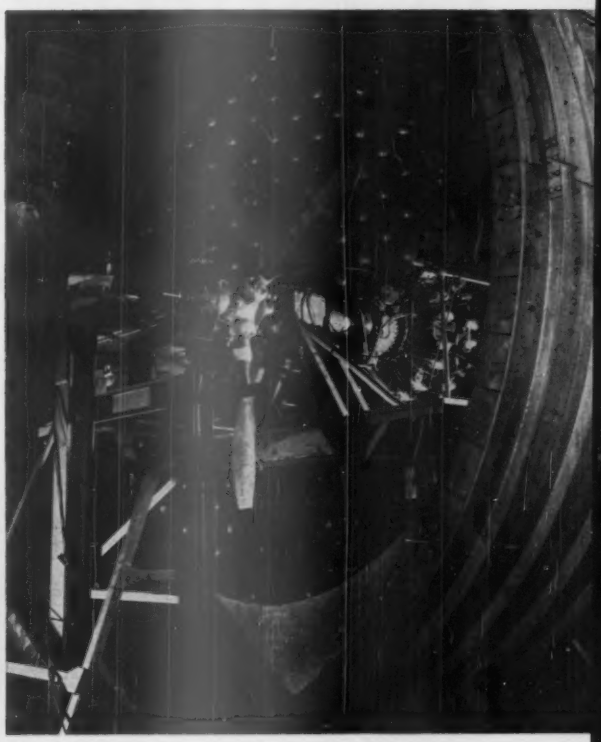




CURTISS-WRIGHT glass fiber propeller is tested in gyroscopic whirl rig which induces stresses in excess of normal flight stresses.

Glass Fiber V/STOL Propeller Is Tested

Low-cost glass fiber propeller for V/STOL aircraft has been developed and tested by Curtiss-Wright Corp.'s Propeller Division.

Blades weigh about half of equivalent hollow-steel or solid aluminum alloy blades, the company reports.

The new propeller design is an outgrowth of C-W's work with its Model 100 and 200 VTOL designs, and has been tested extensively in flight on the Model 100 vehicle. Wind tunnel and simulated flight tests, plus vibration endurance and ground erosion runs have been a major feature of the development program.

Commercial Market

As a result, the company says it is now ready to tackle the commercial market for these new types of propellers, demanded by the unconventional flight regimes of V/STOL aircraft.

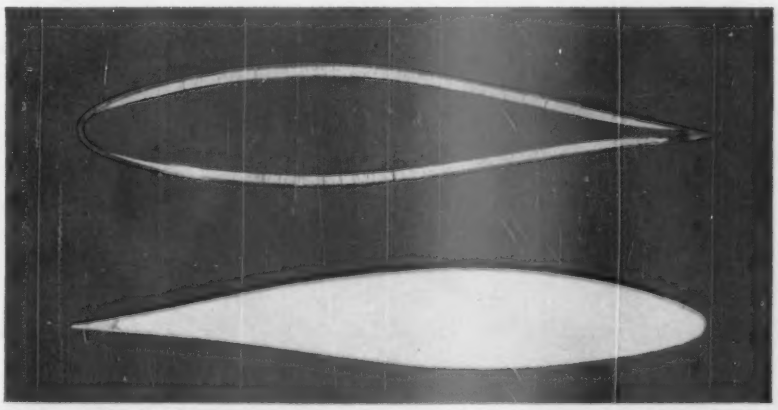
Basic structural material is glass fiber weave with either uni-directional or bi-directional fiber orientation. Seamless monocoque blades are molded integrally with a steel blade root for attachment to the hub. Blade is held to the shank mechanically, so that bonding between the plastic and the steel is an extra.

Two fundamental configurations have been developed; sandwich-wall construction, generally to be recommended for larger blades, and foam-filled, for smaller blades. Choice of the type depends primarily on the specific application; construction type influences both stiffness and deflection of the blades.

Fabrication technique is unusual and involves a flexible bladder, held in a core mold and filled with low-density beads. By evacuating the bladder, the shape can be held after removal from the core mold. This shape then serves as the mandrel for further lay-up of the glass fiber weave.

Alternate layers of various sizes of cloth with uni- and bi-directional fibers are laid up around the mandrel. If the construction is to be sandwich-wall, preformed panels are added during the lay-up.

Blade root area is filament-wound



TWO TYPES of blade construction are shown; sandwich-wall construction (upper) recommended for large blades and foam-filled (bottom) for smaller blades.

MIL/SPEC
GM-07-59-2617A

...Implemented by Capehart's INTERDICT GROUP

A veritable thicket of specifications has grown up around radio frequency interference measurements. Specification GM-07-59-2617A appears to be one of the thorniest. If you are having problems implementing this, or are experiencing any other difficulty connected with RFI, contact the INTERDICT Group from Capehart.

INTERDICT (for Interference Detection and Interdiction by Countermeasures Team) is a unique service. It began with the numerous field studies our engineers were carrying out. It grew into a series of mobile RFI measurement vans, an expanded force of engineers, a manual on RFI prediction by mathematical procedures, cognizance of all current military and industrial communications/electronic equipment, and formal organization into a team led by Dr. Joseph Vogelman, widely-known authority on RFI detection and elimination.

The engineers from INTERDICT are completely competent to aid in establishing: systems analysis, design limitations, criteria and test procedures. Follow through by INTERDICT engineers in the actual performance of these tests assures complete implementation of GM-07-59-2617A or any other relevant MIL Spec*. They have performed numerous systems and site analyses resulting in the prediction, detection and elimination of interference at such complex sites as Cape Canaveral and Vandenberg AFB, frequently before r-f interference occurred. They can offer you studies of this magnitude, or of very limited application, depending on your needs. INTERDICT possesses the men, the vans, the materiel, and the experience to analyze a complete proposed missile system, an individual site, or a single piece of installed equipment. The "package" can be tailored to the requirement.

The INTERDICT Group analyzes a proposed system for all r-f radiation sources, makes the necessary field measurements, predicts and determines the causes of interference, and recommends the proper remedial action. Should this latter require any equipment not commercially available, Capehart's quick-reaction engineering and model shop can provide what is needed very rapidly.

Capehart's INTERDICT offers the first world-wide packaged service to analyze and counteract radio frequency interference. It also provides for elimination of electromagnetic radiation hazards to personnel and materials such as squibs, ammo, fuel. All service is performed in compliance with applicable MIL Specifications such as that noted. To avail yourself of these unusual services, contact:

*Such as MIL-I-26600, I-6051, T-9107, S-10379, etc.

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around the steel shank on a controlled schedule and specified tension.

"Special techniques"—presumably a proprietary portion of the process—tighten the fibers so that the material can be molded free of wrinkles. Curing is done in a heated hydraulic press; during the cycle, the vacuum in the bladder is replaced with nitrogen under pressure to produce a finished seamless blade.

Studies on lightweight propellers began in 1956, and in February, 1958, the company's designers started work on the seamless blade type. Initial blade was formed in August, and the first propeller was wind-tunnel tested in September, 1958. From October through December, the company ran full propeller tests on its gyroscopic test rig, which simulates the vibratory stress conditions of V/STOL aircraft propellers. First runs on the Model 100 VTOL test vehicle began in January, 1959.

Parallel effort to propeller development was a materials and process control program aimed at finding steady-state and vibratory stress limits of the glass fabric material. Fatigue tests, most of which were carried out to 50 million cycles, were made on basic material samples. The blades themselves have been tested beyond 100 million stress cycles.

Curtiss-Wright cites the usual advantages of glass fiber construction—lower cost because of fabrication techniques, lighter weight because of the better strength-density ratio of the material, control of mass and stress distribution by arrangement of material, low notch sensitivity, freedom from corrosion, high damping characteristics. The company says de-icing gear can be built in if desired, and that less electrical power is required for de-icing because of reduced conductive losses through the material.

Leading-edge abrasion protection can be provided depending on needs.

Similar approach to the design of helicopter blades has been taken by Kaman Aircraft (AW Apr. 10, p. 67).

Air-India to Acquire Turbojet Test Plant

Air-India will have its own turbojet overhaul and testing facilities completed by 1962, according to an airline spokesman.

The new plant will be located in Bombay, will cost approximately $1,050,000 and will cover an area of 62,000 sq. ft. The plant is expected to be able to service engines up to 30,000-lb. thrust and will be able to overhaul 10 Conway engines per month.

Rolls-Royce currently performs overhaul servicing for the Indian carrier.

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In addition to producing operational equipment for today's aircraft, RPI is working on second-generation, encapsulated, and other fully-automated escape systems. This engineering support is available to help solve your ballistic/rocket problems. Call RPI, today.
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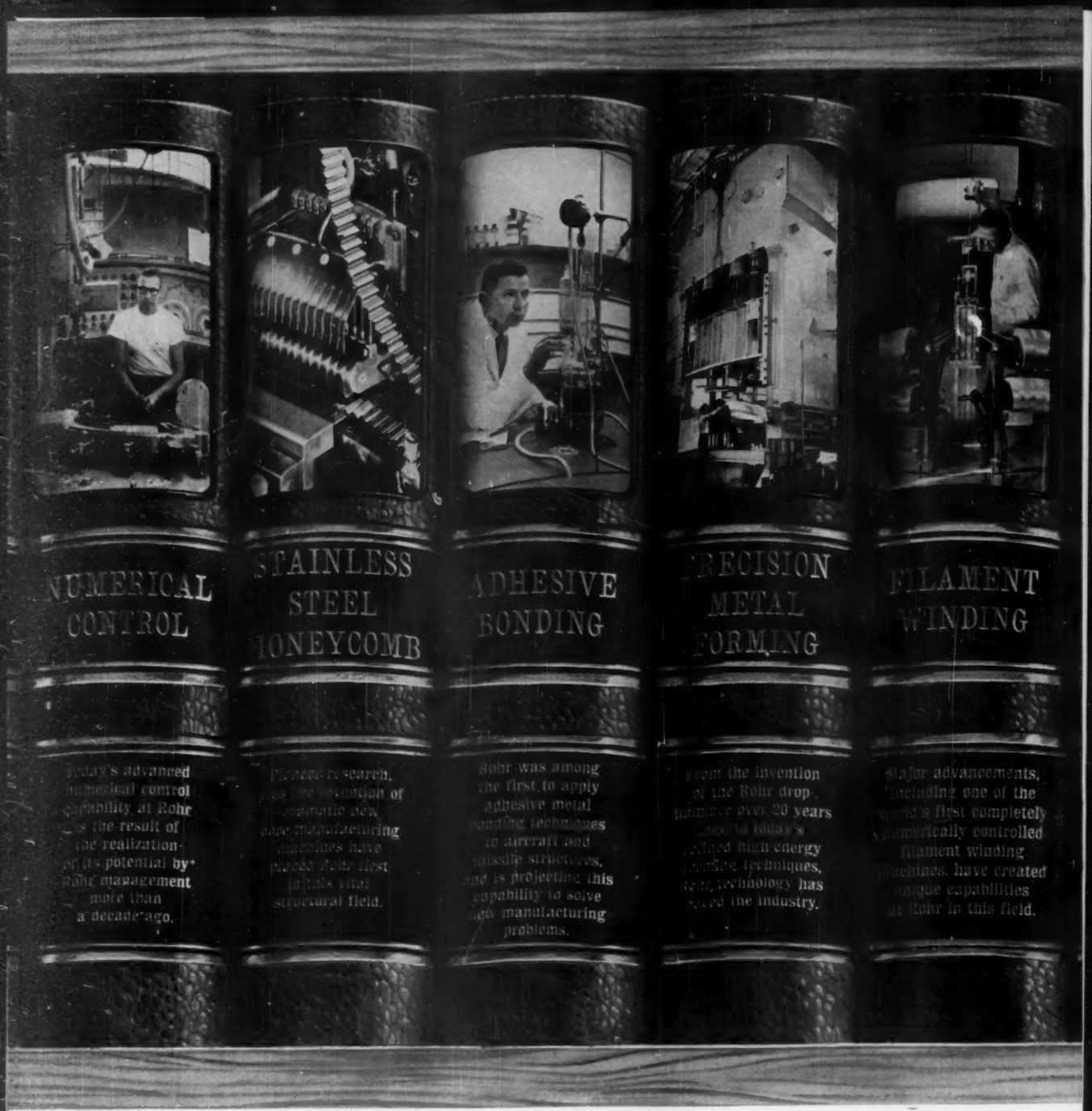
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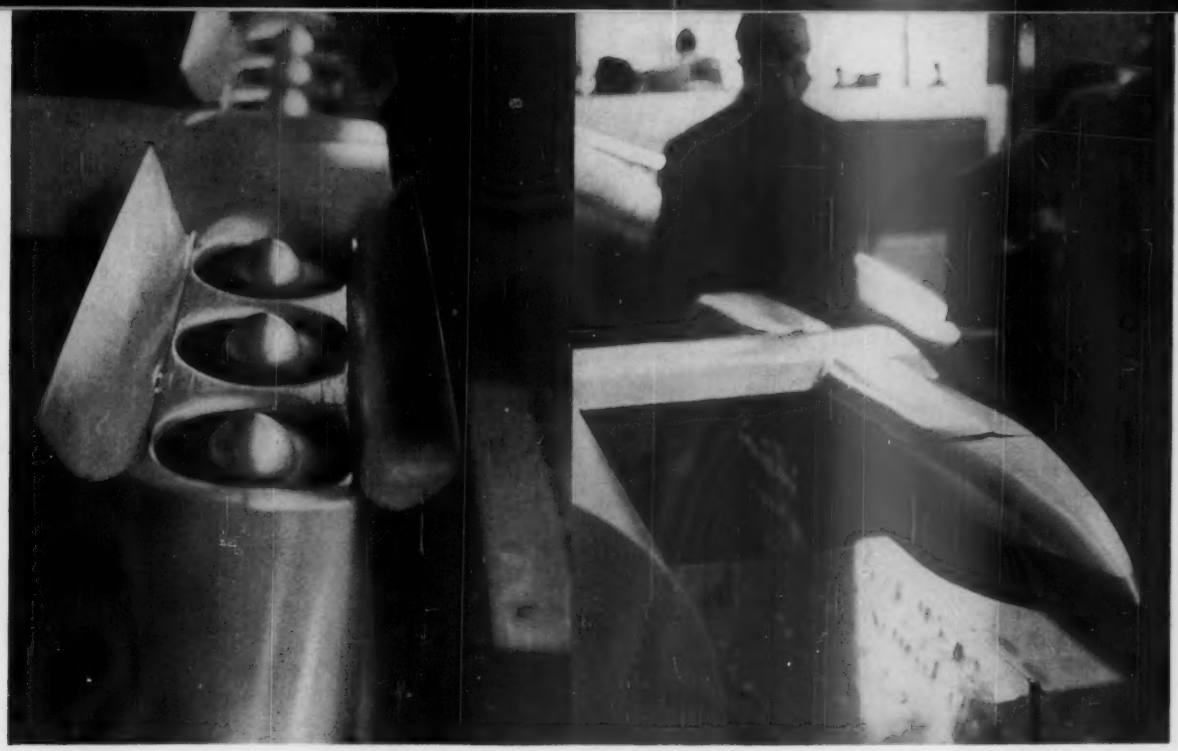
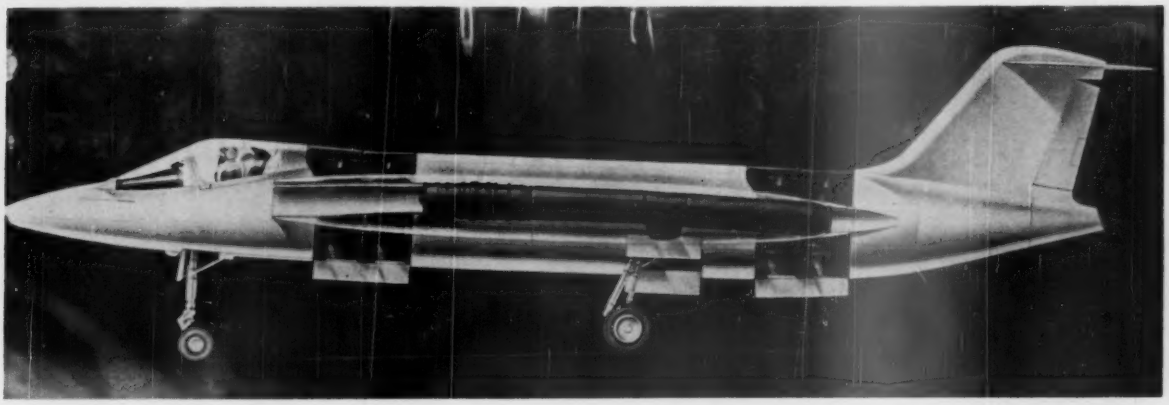


Italy, Germany Display V/STOL Mockups at Paris Show

German Focke-Wulf V/STOL mockup above, displayed at the 24th Paris International Air Show, has wingtip pods which would contain six lift engines covered by panels. Rolls-Royce RB. 162 lift engines probably would be incorporated in the design. Cutaway drawing of Italy's Fiat G.95 V/STOL fighter (AW May 22, p. 75) below, shows incorporation of additional lift engine. Original plans called for four, two in the forward fuselage section and two aft. A fifth engine has been added in the fuselage center section. Only one of the two main powerplants envisioned is shown in the drawing. Plane is Fiat's entry in NATO V/STOL close-support fighter competition.



Air Force Transfers Top-Level Generals

Washington—Air Force has reassigned several general officers in one of its periodic series of transfers among top-level posts and following the nomination of Gen. Curtis E. LeMay as chief of staff.

Gen. Samuel E. Anderson, commander of the Air Force Logistics Command, formerly the Air Materiel Command, will become air deputy to Gen. Lauris Norstad, supreme allied commander in Europe. Lt. Gen. William F. McKee, now vice commander of AFLC, will succeed Gen. Anderson.

Lt. Gen. Bernard A. Schriever will be promoted to full general and will remain as commander of the Air Force Systems Command.

Lt. Gen. Truman H. Landon will be promoted to general and will become commander of U.S. Air Forces in Europe succeeding Gen. Frederic H. Smith, nominated vice chief of staff.

Lt. Gen. Francis H. Griswold, vice commander of Strategic Air Command, will become commandant of the National War College in Washington. Succeeding Griswold will be Lt. Gen. John P. McConnell, now commander of the SAC Second Air Force.

Lt. Gen. Jacob E. Smart, Tactical Air Command vice commander, will become commander of U.S. Forces in Japan and Commander of the Fifth Air Force.

Maj. Gen. Edward J. Timberlake, vice commander of U.S. Air Forces in Europe, will be promoted to lieutenant general and will succeed Gen. Landon as deputy chief of staff-personnel.

Maj. Gen. Gordon A. Blake, vice commander, Pacific Air Force, will be promoted to lieutenant general and will be assigned as commander of Continental Air Command.

Maj. Gen. Gabriel P. Disosway, senior Air Force member, military studies and liaison division of the Weapons System Evaluation Group, will be promoted to lieutenant general

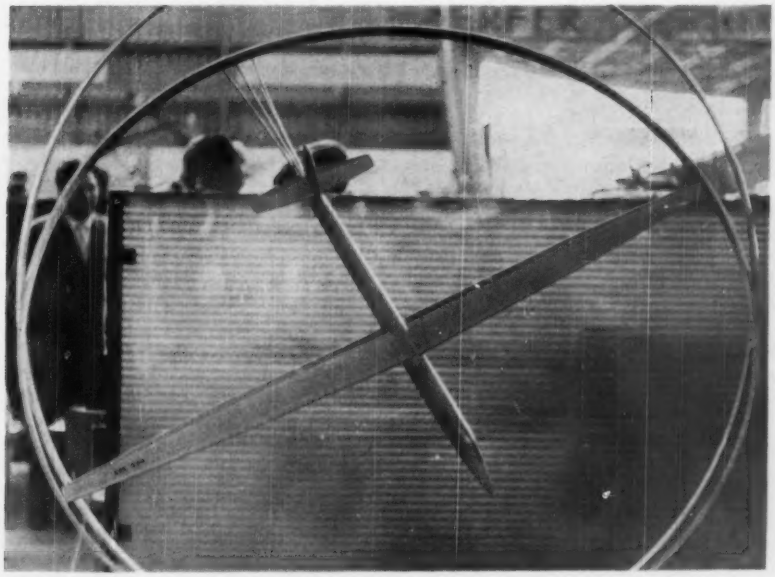
In early 1960, American craft pierced the North Pole in two elements. Fathoms below solid ice, the USS Sargo probed unerringly to "90 North"; miles above, a GAM-77 missile on a B-52 pinpointed the featureless goal. Both used Inertial Navigation systems by Autonetics—where today's results pave the way for tomorrow's breakthroughs.

Electromechanical Systems by **Autonetics** Division of North American Aviation

and become vice commander of Tactical Air Command.

Maj. Gen. Kenneth B. Hobson will be promoted to lieutenant general and will be assigned as vice commander of Air Force Logistics Command. Maj. Gen. Troup Miller, Jr., vice commander of the Air University, will be promoted to lieutenant general and will become commander of the university.

Maj. Gen. Robert H. Terrill, now commander of the Air Proving Ground Center, will be promoted to lieutenant general and assigned as vice commander of Air Defense Command.



MODEL of German two-place DFS 582 powered glider is displayed at Paris Air Show.

DFS 582 to Have 4-hr. Endurance

Paris—Production models of West Germany's two-place DFS 582 high-altitude powered glider, the equivalent of a small-scale Lockheed U-2 (AW May 29, p. 26), are now under construction at Weser Flugzeugbau in Bremen.

Designed by Munich's Institute for Aeronautics, the aircraft are on order by the West German Ministry of Transport and are officially said to be designed to conduct high-altitude weather and radiation research missions.

Design specifications call for the DFS 582 to make a powered climb to 60,000 ft. within 30 min. and to have a non-powered loiter capability of approximately four hours. For descent there is 30 min. reserve fuel for the aircraft's 3,000-lb.-thrust Pratt & Whitney JT12A-6 to permit the pilot to make a powered approach at landing. Maximum range is 1,800 mi.

The JT12A is housed in the rear fuselage section. An inlet duct located on either side of the fuselage just in front of the wings is extended during powered flight, retracted flush with the fuselage during the glide phase to obtain better aerodynamic flow.

With a maximum gross weight of 9,300 lb., the DFS 582 has a maximum payload of 4,000 lb. The instrument package is located immediately behind the two-place cockpit. Fuselage and wings are of bonded light metal sandwich construction with honeycomb.

Maximum speed of initial production versions will be within the Mach .3 to Mach .4 range, but ultimate design specifications call for Mach .6.

The straight wing has a span of 98 ft. and an aspect ratio of 20.

General Dynamics Will Retain Convair Name

Retention of the Convair name at least for its commercial aircraft is planned by General Dynamics Corp., and it has changed the new name of the former Convair San Diego division to provide for this.

In the reorganization dissolving the former Convair Division (AW May 8, p. 45) General Dynamics had renamed the San Diego operation General Dynamics/San Diego. Since then, the name has been altered to General Dynamics/Convair.

The Convair name may also be used in military aircraft and missile designations, but the corporation policy on this has not been formulated yet.

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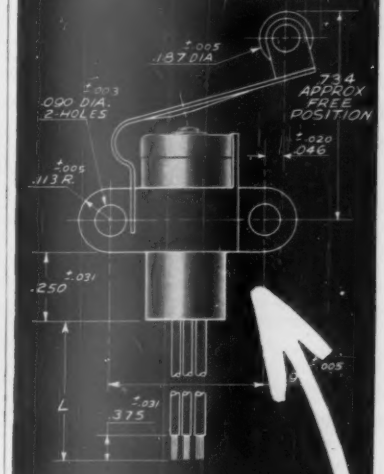

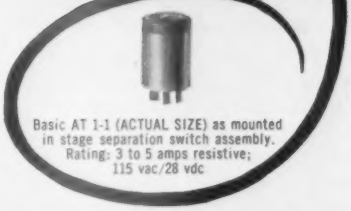

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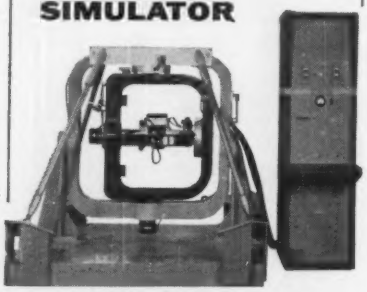

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Convair have been named presidents of the new General Dynamics divisions and senior vice presidents of the corporation. They are:

- **J. R. Dempsey,** General Dynamics/Astronautics.
- **Charles F. Horne,** General Dynamics/Pomona.
- **Frank W. Davis,** General Dynamics/Ft. Worth.
- **Robert C. Loomis,** General Dynamics/Convair.

All were former Convair vice presidents. In their new titles, they report to C. Rhoades MacBride, General Dynamics executive vice president in charge of the western divisions.

Other changes include appointment of Robert H. Biron, former vice president-administration for the Convair Division, as corporate vice president-industrial relations, and Roy R. Brewton, director of government accounting; Chester L. Meador, director of contracts, and Stanley E. G. Hillman, director of material, all corporate-wide positions at San Diego.

PRODUCTION BRIEFING

North American Aviation Space and Information Systems Division has a 13-month Air Force study contract to improve optical satellite observation and prediction techniques.

Curtiss-Wright Corp. has consolidated its propulsion activities under the direction of the Wright Aeronautical Division, Wood-Ridge, N. J. Purpose of the move is to coordinate propulsion and development programs.

Kincheloe AFB, Mich., became the first site to be equipped with Boeing Bomarc B surface-to-air missiles earlier this month.

Federal Aviation Agency issued type certificates for the Pratt & Whitney JT3D-3 turbofan engine and the JT3C-12 turbojet. The JT3D-3 is an uprated version of the previously certificated JT3D-1.

Dunn Engineering Corp., Cambridge, Mass. has received a $100,000 contract from USAF's Holloman Missile Development Center for equipment to test extremely sensitive gyroscopes in missile inertial guidance systems.

Waltham Laboratories of Sylvania Electric Products, Inc., Waltham, Mass., a subsidiary of General Telephone & Electronics Corp., has received a multi-million dollar contract from the Bell Telephone Laboratories for the development of an advanced radar design for possible future incorporation into the U. S. Army's Nike Zeus anti-missile missile system.

ITT Federal Laboratories, Ft. Wayne, Ind. has received a USAF contract to study possible designs of automatic, standardized equipment for testing and checking out inertial guidance systems under the Air Force's new Project VATE (versatile automatic test equipment) which has as its objective the standardization and automation of USAF missile test equipment.

Kollsman Instrument Corp., Standard Kollsman Industries, Chicago, Ill., has been selected by General Electric Co. to develop and manufacture six star trackers for each of three Orbiting Astronomical Observatory (OAO) spacecraft now being built by Grumman Aircraft Engineering Corp. for a scheduled launching in 1963-64.

E. I. du Pont de Nemours and Co., Wilmington, Del. has received a $5-million contract from USAF for research and development work in the field of high-energy solid propellants. Research will be conducted at du Pont's Eastern Laboratory, Gibbstown, N. J., for the Air Force Flight Test Center, USAF Systems Command, Edwards AFB, Calif.

General Electric's Flight Propulsion Laboratory Dept. has been granted a $300,000 contract by NASA for a study on electrical space power generation. Contract covers study of turbines for use with nuclear turbo-generator systems. The heat transfer characteristics of metallic working fluids for this system are currently being studied by the GE laboratory under an earlier NASA contract.

Paul D. Jett Co. of Lakeland, Fla., has been awarded a $527,743 contract by Army Corps of Engineers to install 69,000-volt power lines at Complex 37, the second National Aeronautics and Space Administration Saturn pad.

Avco Corp.'s Nashville Division, Tenn., will build components for 18 additional Convair 990 jet transports under a $4-million contract from General Dynamics. The subcontract production includes vertical and horizontal stabilizers, elevators, rudders and wing inboard leading edges and outboard trailing edges.

Automation Industries, Inc.'s Research Division, Manhattan Beach, Calif., will investigate ultrasonic methods to inspect complete solid-propellant missiles after delivery from factory and at launching sites under a $125,000 R&D contract awarded by Navy's BuOrd through Hercules Powder Co. The program runs through 1961 and is concerned primarily with a Phase I Study.

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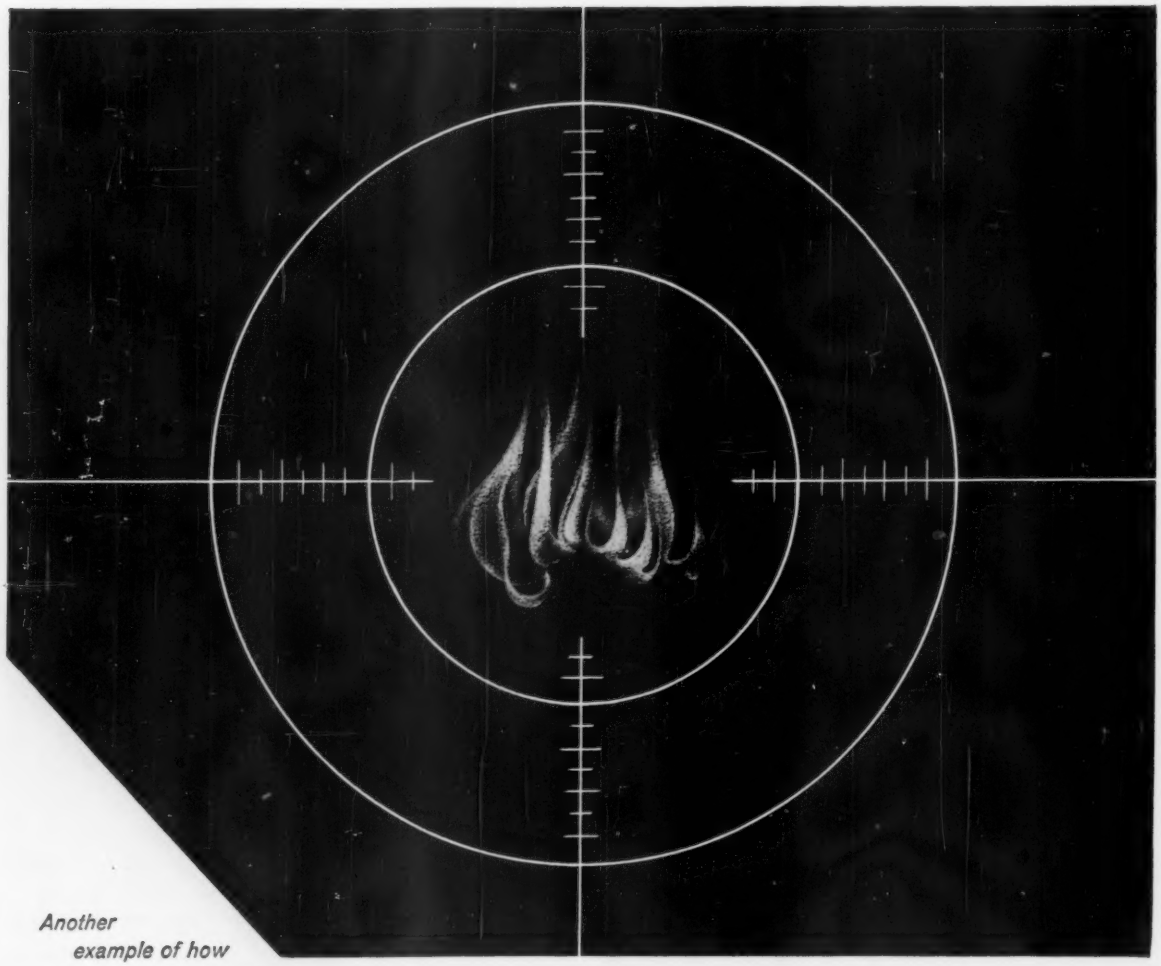

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The same depth of imagination and technical daring is now at work modifying and adapting this sophisticated machine for a variety of civilian and military space missions. Dozens of specialized orbiting and inter-planetary vehicles will depend upon the power of Atlas to thrust them into space.

These programs reach far into the future and require the skills of highly resourceful engineers and scientists in many technical disciplines.

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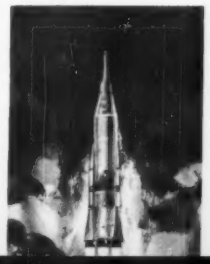

CONVAIR DIVISION OF GENERAL DYNAMICS

MANAGEMENT

Defense Is Evolving New Weapon Plans

By Craig Lewis

Current and future impact of weapon system planning and changes in management policy emerging from the early months of the Kennedy Administration were outlined recently by Pentagon officials to the annual Aerospace Industries Assn. board of governors' conference at Williamsburg, Va.

Deputy Defense Secretary Roswell Gilpatric discussed present weapon plans and future possibilities and Joseph S. Imirie, assistant Air Force secretary for materiel, described management trends toward better integrated, "package" systems. Imirie also explained the impact on industry of the recent Air Force Systems Command-Logistics Command reorganization.

Gilpatric cautioned against taking his remarks as firm Defense Department commitments, and he observed that "it is too early for Mr. McNamara and me to be very clear even in our own thinking." But his discussion clearly indicated some of the directions this early thinking is taking.

For the strategic mission, Gilpatric reiterated the long-standing plan for a mixed missile-manned bomber force through the 1960's with increased emphasis on solid propellant rockets. But he indicated that Defense is considering a long-endurance, subsonic alternative to the North American Mach 3 B-70 as the manned bomber for the late years of the decade, and he cast doubt on the development of any new strategic ballistic missile system unless there is a "dramatic" breakthrough in solid fuel chemistry.

Manned Bombers

Boeing B-52s and Convair B-58s, along with the penetration aids already developed or planned, are the only modern bombers currently programed for this mixed force and they are likely to remain in service through the end of the decade. Defense does not "presently plan" to buy any more of these bombers, even though Congress has authorized further production, Gilpatric said.

But he left the door open for a change. "I use the words 'presently plan' advisedly; future events might change the plan," he said.

Gilpatric also noted that "for the next few years at least" there is considerable flexibility inherent in the still sizable Boeing B-47 force. Both the Eisenhower and Kennedy Administrations have juggled the planned phase-out schedule for this bomber to retain striking power in critical periods.

Explaining Defense Department's approach to the B-70 program, Gilpatric noted that aircraft development will continue—in effect, "buying an option" on full B-70 weapon system development for $1.3 billion instead of the estimated $2.7 billion needed to run a complete weapon system development program.

This approach preserves freedom of action for Defense and does not commit it "solely to ballistic missiles as we know them today." Gilpatric said the department will continue to welcome any new concepts for strategic delivery systems that promise improvement over older methods. But he warned:

"The acceptance of new concepts for production and for introduction into the inventory of deployed weapon systems must, however, be a decision based on cost and effectiveness comparisons of the various systems that might be applied to the mission during the same time period. Furthermore, these cost-

B-58 Tests Downward-Ejection Escape Capsule

B-58 with modified escape capsule pod, now undergoing downward-ejection tests, lands at General Dynamics/Ft. Worth base. Upon completion of downward—and upward—ejection tests, all B-58s will be equipped with escape capsules designed to protect crewmen from weather and wind blasts during ejection up to and beyond Mach 1.

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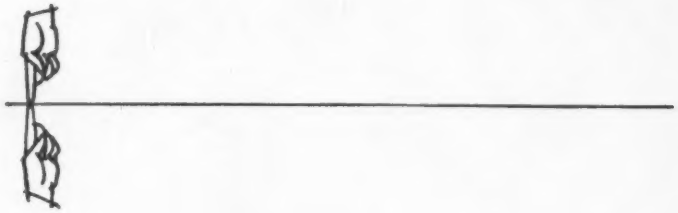
no thicker than (0.003″) 

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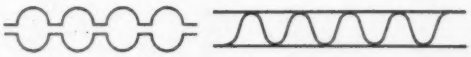
and made into sandwiches  provide

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effectiveness comparisons must be made with full accounting of such factors as the lack of a man in a ballistic missile."

Among approaches visualized for future manned systems, Gilpatric mentioned low-level penetration aircraft, an improved high-altitude bomber and "an aerodynamic-type vehicle in the rarified atmosphere. Manned maneuverable space vehicles are not beyond speculation."

In the same period as the B-70 is to be operating, he pointed out that a "stand-off" bomber could be developed. This could be a low-speed, long-endurance airborne launching platform carrying an advanced air-to-ground missile of the Skybolt type.

This is similar to the Dromedary concept proposed several years ago. It would probably evolve as a turboprop aircraft with endurance ranging up to two days, and it might have the flexibility to perform defensive functions (AW June 12, p. 266).

Airborne command and control posts are a requirement, but Gilpatric said this need probably can be met by adapting a transport or a stand-off bomber type.

Dyna-Soar is being accelerated in development as a research vehicle, but Gilpatric noted that it has not been committed beyond the first phase and that "it is unclear at this time whether Dyna-Soar will ever be reduced to a military weapon system."

The planned 13-squadron USAF-Convair Atlas and reduced 12-squadron USAF-Martin Titan programs will be completed, but Gilpatric made it clear that solid fuel missiles—primarily the Navy-Lockheed Polaris and USAF-Boeing Minuteman—hold higher interest for the new Administration. He said efforts to improve their performance will continue and "at a somewhat lower priority, we also look forward to some improvement in the Titan II weapon system." Titan II also is to be used in the space program.

Missile, Space Market

"Unless we can achieve a dramatic breakthrough in a solid fuel chemistry—and this is a possibility which should not be excluded—it is difficult to visualize an entirely new strategic ballistic missile development in the near future," Gilpatric said. "As you have heard, there has been a lot of talk about a mid-range land-based tactical ballistic missile, for which there is not yet, however, a firm requirement.

"There may also develop a future requirement for a surface ship-based ballistic missile—perhaps either Polaris or some new solid fuel missile, but it would have to have a much better cost-effectiveness ratio than the proposed installation of the Polaris on the nuclear-powered cruiser Long Beach," he said.

Gilpatric noted that space projects and their related supporting programs already account for about $1.1 billion in the Fiscal 1962 defense budget, and "one can safely predict that the amounts allocated to these projects in the future will be even greater. Taken together with the anticipated increases in the budgets of other agencies, particularly NASA, the space program is clearly destined to become a major market for the aerospace industries."

Major new elements of the military space effort are the Air Force solid booster program and the efforts to develop a new high-energy upper stage for Titan II to provide a backup vehicle for Atlas-Centaur and for other possible military use. Gilpatric noted that the large solid booster program is directly related to the national lunar program, but he said that "we may find that it will open up a new technology for eventual military applications."

Nike Zeus is to remain in research and development, a phase of the program scheduled to cost about $1.75 billion. Despite the uncertainty involved in postponing a production decision, Defense Department feels it does not have a sound basis on which to decide now. More advanced missile defense

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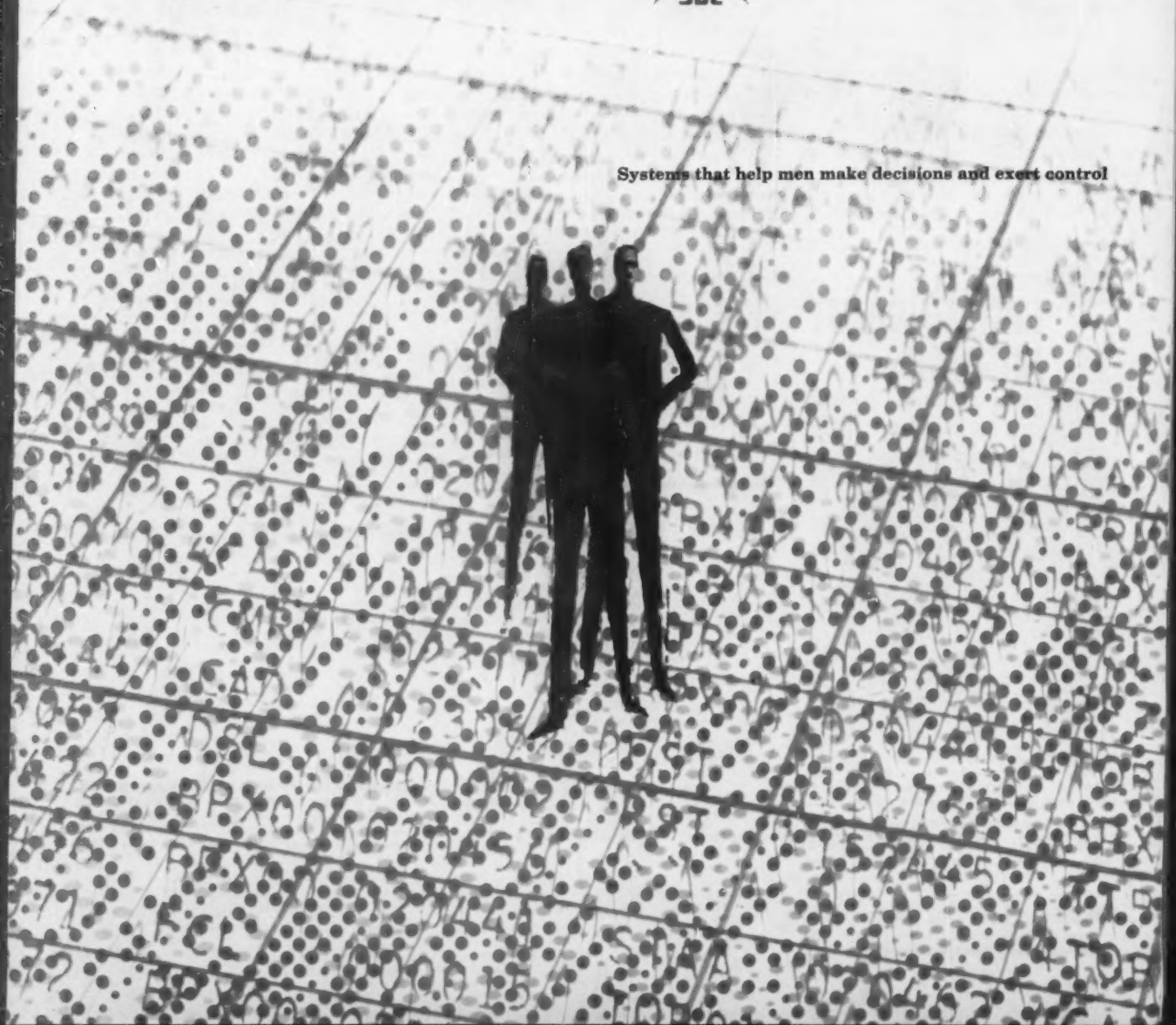
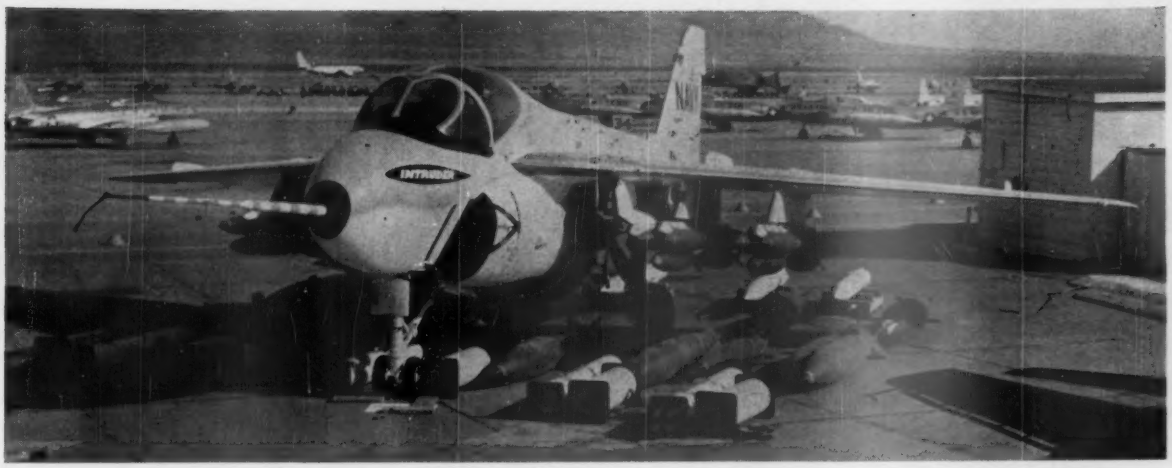
SDC



Systems that help men make decisions and exert control



Grumman Shows A2F's Conventional Weapon Armament

Two-place carrier-based Grumman A2F low-level attack bomber designed for nuclear or conventional weapons displays its conventional armament of Aero 7D rocket launchers with 19 rockets (front row, short capsule); Aero LAU-10A package of four 5-in. Zunies (front row, long capsule); Mk. 83 1,000-lb. and Mk. 84 2,000-lb. bombs. In the rear (white) are ASMN 7A Bullpup missiles and under the wing in clusters of three are 500-lb. bombs.

studies are continuing under Project Defender at a current spending rate of over $100 million a year.

Gilpatric stressed the new Pentagon policy of using the tri-service approach in developing new aircraft (AW June 12, p. 36). "We have no choice but to reduce to a practical minimum the number of different types of tactical aircraft we undertake to develop and produce," he said.

"There simply is not enough volume in the offing to justify a large number of different types, and we cannot afford to pay the high premium on short production runs of very complex aircraft."

Gilpatric conceded that it might be impossible to design a single aircraft to cover all the tactical needs of the services, but he said it should be possible to develop one aircraft for all similar missions. Thus, the tri-service fighter now in the planning stage should be able to perform air superiority, interdiction and reconnaissance roles for all the services if it can be made compatible with carrier operation.

A second tactical fighter might be required for the close-support and light attack role, he said, "provided this aircraft is needed in large numbers and can be produced considerably more cheaply than the larger and more sophisticated fighter."

Observing that inter-theater airlift requirements are "pretty well in hand" with the orders for C-130Es and C-135s and development of the C-141, Gilpatric said limited and "cold" war requirements call for development of vehicles to improve local air mobility. Here again, the tri-service approach will be used to reduce the number of different vehicles involved, especially for transport.

A tri-service VTOL transport program already is under way in this area. Gilpatric noted that this represents a step toward advancing the state of the art beyond the helicopter, which is "an aircraft of essentially limited effectiveness . . . very expensive and difficult to maintain." He said the tri-service VTOL effort should not preclude thinking about other more radical concepts.

"There will most certainly continue to be a need for rugged-and-simple-to-maintain air vehicles which are capable of operating from completely unprepared fields and in primitive environments, at the end of long supply lines and without extensive local logistics support. Such vehicles would be extremely useful in the kind of limited war situations we are most likely to encounter in the years ahead," he said.

Profound Influence

"Equally important, the successful development of such vehicles could exert a profound influence on our present tactical doctrine. And we still need some new tactical doctrines if we are to successfully cope with the new tactics adopted by our adversaries."

Gen. Clyde D. Eddleman, Army vice chief of staff, told the conference that the Army needs a 3-4-ton capacity VTOL or STOL replacement for the Boeing-Vertol Chinook helicopter and de Havilland Caribou STOL transport soon to be in service. He said the tri-service VTOL could fill this need, but a gap would still remain between such a VTOL transport and the Lockheed C-130.

To fill this gap, the Army would like to have a "true assault transport" with a 10-12-ton payload that could operate from unimproved areas in combat zones and a 10-12-ton capacity VTOL system to carry equipment on short trips across such obstacles as rivers, swamps, jungles or mountains.

Gilpatric noted the shift in cost-reimbursement type contracting from less than 13% when he served as assistant secretary in the Air Force in 1951 to nearly 43% of current procurement. Whatever the reason for this trend, he said the fact remains that "cost-reimbursement contracts weaken the incentive for economy and place increased responsibility for close surveillance over costs, not only on our contract administrators but on industry management as well. We simply cannot do the whole job in the Defense Department.

"In the final analysis, the major part of the job rests with management in industry; you are the ones who actually spend the money. What we can and should do is to work out a practical, acceptable system for rewarding good cost performance through greater profit incentives, while penalizing substandard performance through reduction in profits or fees," he said.

Gilpatric also expressed concern over the problem of competition—negotiation vs. formal advertising, sole-source procurement and other issues. He said an analysis of contract awards in the last six months of 1960 showed that 60% in dollar value involved no competition, including 25% for sole-source procurement and 35% for follow-on contracts after initial contracts were awarded competitively.

Congress and the public are highly suspicious of non-competitive procurement, he said, and we must "do everything possible to assure competition, regardless of whether the procurement is made [through] formal advertising or

nozzle spray patterns tell a story of performance

. . . under the critical eyes of high-speed cameras. Perhaps they validate Ex-Cell-O Flight & Space Engineering's predictions of flow characteristics of a prototype nozzle designed for an advanced powerplant or fuel; or perhaps they prove the uniformity and accuracy of mass-produced components. ■ Research in airborne fuel systems hydrokinetics is but one capability Ex-Cell-O can immediately apply to your aerospace projects. Others include: Unusually complete prototype and production testing facilities . . . highly developed techniques for machining and fabricating modern metals from the solid or sheet . . . and imaginative design and development of diverse hardware for the fields of aircraft, missiles and atomics. ■ Contact our Representative nearest you, or write direct for detailed information.

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XLP

through negotiation." He pointed out that the services have been told wherever possible to define requirements and allot funds well in advance of contracting, to provide technical data as early as possible and to prepare specifications "in a timely manner."

The Armed Services Procurement regulations also have been changed to require that most defense procurement, whether formally advertised or negotiated, be publicized through the Commerce Department.

USAF Assistant Secretary for Materiel Joseph Imirie told the AIA governors there is an Air Force trend toward "package" programs, highlighted by formation of Air Force Systems Command, and that he sees a major implication for industry in this.

"Under Mr. McNamara's and Mr. Hitch's philosophy of assembling mission area program packages, our system package program becomes a critical element. It goes without saying that the accuracy and validity of the data, cost estimates and cost projections, anticipated and actual performance and feasibility of attaining milestones will determine to a major degree whether there is a favorable or non-favorable decision at the highest level for continuation of the program.

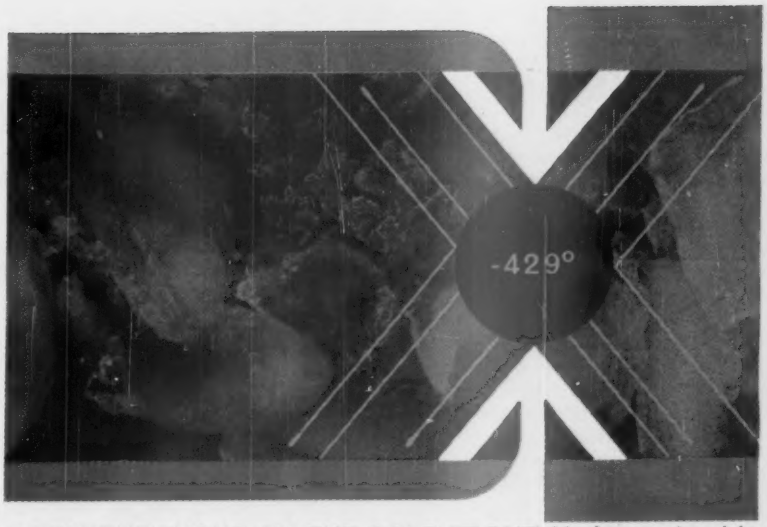
"I can assure you that, once approved for implementation, each of these package programs will undergo continual surveillance for reduction of costs," he said.

Imirie observed that while USAF has been the most vocal service in selling the merits of the system management approach for large, complex programs, the Navy "has come much closer to the ultimate" with the Polaris program. He said the Polaris management technique has become almost a government standard. The PERT technique, later adapted by USAF, the National Aeronautics and Space Administration and several companies, was developed in the Polaris program.

"In my opinion," Imirie said, "this is a foreshadow of a continuing way of life for the foreseeable future. The direction and guidance emanating from the secretary of defense's office clearly indicates an intent to obtain greater sophistication of the 'system management' concept."

Reviewing the background for the recent Air Force reorganization which produced the Air Force Systems Command and Air Force Logistics Command, Imirie said that studies made over the years had made minor, relatively insignificant improvements in the management system for developing new systems.

Two years ago, a top-level study group was formed and spent a year reviewing the situation. It considered but did not recommend major changes



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in functions and organizations. Imirie said the study largely produced a refined and detailed series of regulations for conducting USAF system management.

"Shortly after Gene Zuckert took over as secretary, he and the chief of staff, Tommy White, decided to face squarely the organizational problems in the field," he said. "They did. On March 17 the reorganization was announced for effectivity on April 1 with all changes to be completed by July 1, 1961.

"I might add that Mr. McNamara's decision in early March to assign the major space development mission to the Air Force probably expedited the reorganization action."

For industry, Imirie feels it is significant that very few people will be moved in the process of the reorganization. Companies will continue doing business with existing procurement and contract administration offices—they will simply be working for AFSC rather than the logistics command.

AFSC responsibility covers advanced technology, test, procurement, production, contract management and site activation. These functions are to be performed from the time USAF issues a requirement until the last unit is delivered from the production line. Thus, industry contractors will deal primarily with a single authoritative source.

Imirie said System Program Directors will be given maximum authority and responsibility and will be the primary contact point for the Air Force on individual systems.

During the acquisition phase, AFSC will budget for and buy all items required for a system. USAF plans to use the "System Package Program," under AFSC cognizance initially, as the "single summary integrated planning, programing and implementation document for systems proposals, acquisition, training, operation and support," he said.

Logistics command is to be responsible for logistic support planning, policies and criteria. It will determine how much support equipment, spares, ground equipment and government-furnished equipment will be needed for a system, and it will purchase replenishment equipment, spares and services.

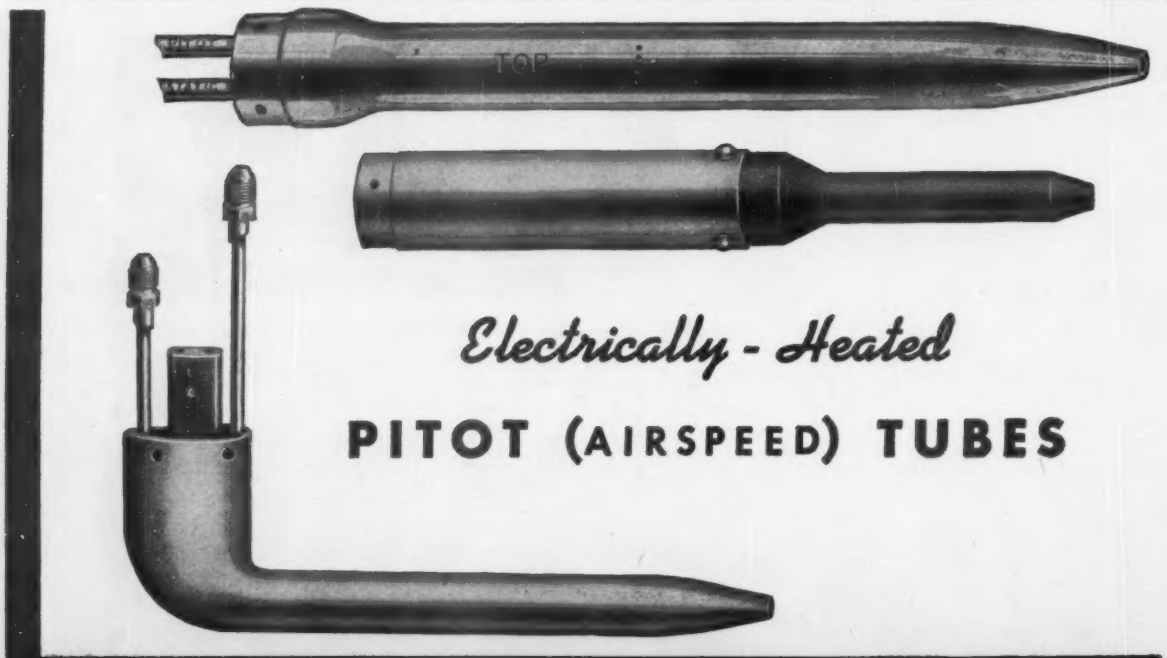
Imirie said that industry will have its initial contracts with AFLC through the System Program Office while a system is in the acquisition phase. The SPO will have representatives from logistics command and the appropriate operating command. He said the Logistic Support Manager concept will be retained, and "during the operational phase of any system, your usual contacts will be with the AMAs and depots."

Financial Briefs

Westinghouse Air Brake Co. announced first quarter 1961 consolidated sales were $38,948,874 compared with sales of $46,757,163—a 16% decrease from 1960 first quarter sales. Earnings were $3,288,826 compared with $3,902,273 for the same period last year. Net income after taxes was $1,657,811 for the 1961 quarter or 39 cents per share on 4,208,961 shares of stock outstanding compared with last year's first quarter net income of $2,008,417 or 48 cents a share on 4,206,761 shares outstanding.

International Rectifier Corp. reported sales for the nine months ended Mar. 31, 1961, of $10,763,278 compared with $9,934,386 for the same period in 1960. Net income after taxes was $928,201 or 38.5 cents a share on 2,405,994 shares outstanding. This compares with $924,248 or 38.4 cents a share for an equal number of shares in the same period in 1960.

Lear, Inc., sales for the first three months ending Mar. 31, 1961, were $24,154,639 compared with last year's first quarter sales of $22,818,337. Net earnings for the current quarter were $580,026 or 21 cents a share on 2,756,235 shares outstanding.



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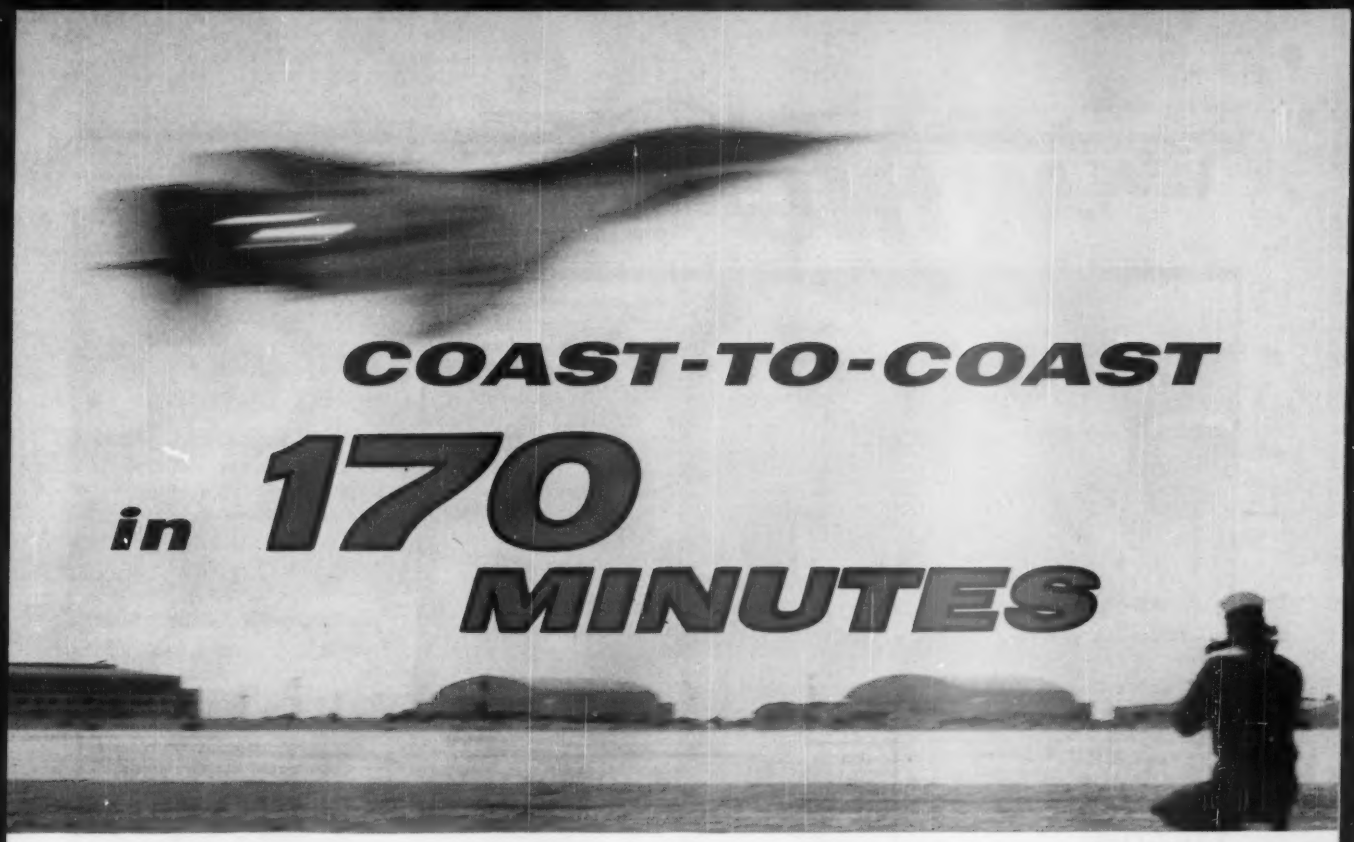

COAST-TO-COAST in 170 MINUTES

Crossing the continent at the rate of a mile every four seconds, Navy Pilot Lt. R. F. Gordon and Radar Intercept Officer Lt. jg D. R. Young flew a McDonnell Phantom II from Los Angeles to New York in two hours, 48 minutes, 44 seconds on May 24, 1961 to win the Bendix Trophy Race and establish a new record for the distance.

The record was set minutes earlier by Lt. Commander L. S. Lamoreaux and Lt. T. J. Johnson in another Phantom II. Their record was two hours, 58 minutes, 19 seconds.

The lead crew, Commander J. S. Lake and Lt. jg E. Cowart flashed over New York in their Phantom II even before the other two to break a three-year old record established by an Air Force RF-101 Voodoo, also built by McDonnell. In all, the last *seven* west-to-east transcontinental speed records were set by pilots flying aircraft built by McDonnell. The Navy's carrier-based all-weather Phantom II also holds the world's 100 kilometer and 500 kilometer closed course records. Setting these distance and maneuvering records requires a very high straight-line speed capability. Security permits only the statement that maximum dash speed for the Phantom II is "in excess of 1500 mph."

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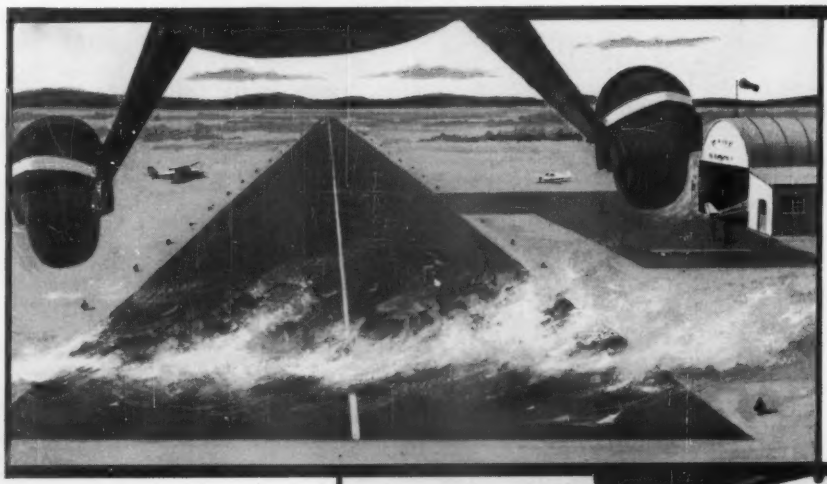
WING TIPS



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While making your approach, keep a keen eye out for low level, wind-blown dust near the runway. If it's moving in a different direction than the wind sock, you should expect turbulence or cross winds as you're touching down.

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Sounds fantastic, but many a carefree pilot has taken off with a seat belt dangling out the door of his plane. In flight, a dangling seat belt can create terrific noise – even damage – as it raps against your fuselage. So keep seat belts inside . . . and fasten 'em!

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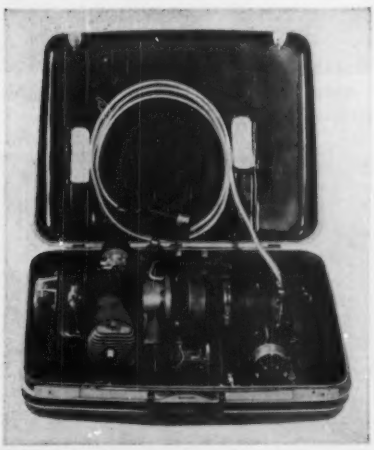
Vane pump cartridge, measuring ¾ in. in diameter, is intended for fluid circulation in cooling avionic equipment, low-power source for small-scale hydraulic systems and pumping fuel for small engines.

The pump delivers 0.1 to 1.3 gpm. at pressures from 50 to 1,500 psi. Displacement is 0.003 to 0.013 cu. in. per revolution and speed range is 8,000 to 26,000 rpm. Operational life of the pump, which weighs 1 oz., is up to 1,000 hr. The unit can be integrated with mechanical and servo valves and can be manifolded in multiple elements in either series or parallel circuits.

Vickers, Inc., Sperry Rand Corp., Detroit 32, Mich.



Portable Power Supply

Self-contained gasoline powered 28-v. d.c. power supply for aircraft is intended for auxiliary starting power, battery charging and ground tests of electrical equipment.

The Portable Power Pak is intended for business aircraft from single-engine models through DC-3 and Lodestar class twins. The 4,000-rpm. two-cycle engine is started by a rope recoil starter and develops 100 amp. for 3-5 min. or 75 amp. continuous. Fuel capacity is one pint. The auxiliary power unit is housed in a magnesium suitcase measuring 21 x 27 x 9 in. Weight is 60 lb.

Allied Instruments, Inc., Houston, Tex.

Emergency Radio Beacon

Emergency radio transmitter, carried by North American Aviation pilots, broadcasts a homing signal in the event of bailout. The radio, which is actuated automatically upon parachute opening, transmits on 243.0-mc., military UHF guard channel.

The radio signal can be used for homing by aircraft equipped with UHF/DF gear or permit triangulation if received by two or more ground stations. Maximum range of the line-of-sight radio is 70 mi. and endurance is 4 hr. The transmitter measures 5¾ in. x 3⅜ in. x 1¼ in., the mercury battery, 8 by 3¾ in. x 1¼ in.; total weight is 1½ lb. The unit price is about $300.

Telephonics Corp., Huntington, N. Y.

Jet Thrustmeter

Thrustmeter, based on exhaust nozzle pressure, measures gross thrust of jet and rocket engines, both in flight and on the ground.

The thrust measuring system incorporates a computer, panel-mounted indicator and a pressure rake in the exhaust nozzle. Gross thrust is computed from total pressure on the exhaust rake and ambient pressure from the static system or other source. Total error in thrust indication is said to be within 1% of full scale. System weight is 12 lb.; power consumption 30 watts, 400 cps., 115 v.a.c.

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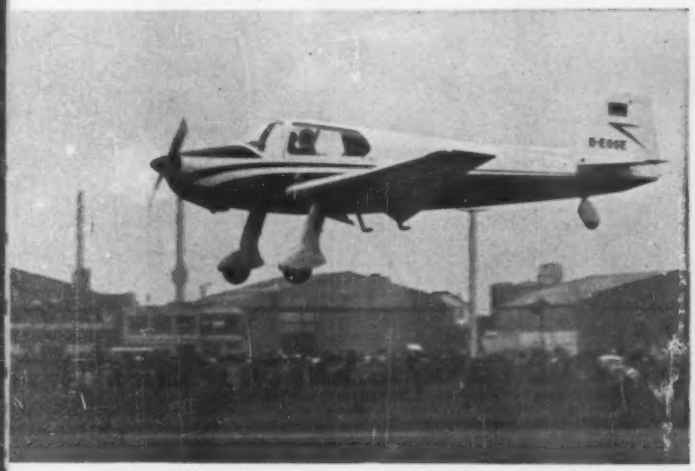
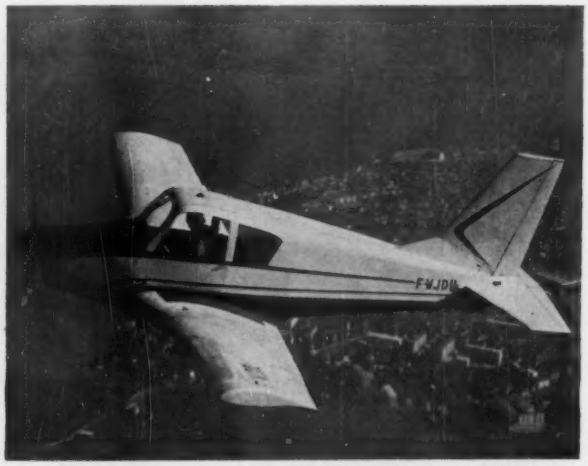
POTEZ-HEINKEL CM. 191, follow-on from the Magister jet trainer, is shown at Paris in executive interior fittings. Canopy slides rearward.

European, U.S. Business Planes Vie in Paris





BOLKOW F.207 executive makes a slow flight demonstration at Paris. Note large tail wheel with plastic fairing. Gardan GY-80 (right) is new French lightplane powered by a 150-hp. Lycoming O-320 engine but can take a 160-hp. Lycoming O-320B.

DOMINANT FEATURE of the Morane-Saulnier Super Rallye is the large leading edge slat for high lift characteristics. Control wheels (right) in Super Rallye can be stowed in upward position for easy entry and exit.

UNUSUAL SPEED BRAKE extends from Procaer F.400 Cobra's center fuselage, shown landing after Paris Air Show demonstration.

Flight Display

By Herbert J. Coleman

Paris—Europe's lightplane builders moved their top aircraft to the Paris Air Show determined to buck established U.S. business aircraft entries and, in the flight demonstrations at least, succeeded.

It was in this phase of the show that the European designs took the spotlight from the U.S.-built planes, particularly the familiar Beech, Cessna and Piper lines. The light twins were confined to comparatively stolid flybys (one propeller feathered) but the Europeans concentrated on high performance in a limited field of view.

The European pilots flew with such vigor that a dozen or so were warned to cease and desist by the show management, and one Italian pilot, Guido Carestiato, was not allowed to fly his Macchi 326 two-place jet trainer in the final day's flying display.

Carestiato, who pulled more than four negative g during inverted climbouts at low altitudes near the crowd, took a typically continental attitude at his banishment from the show. "It is the loss of the French," he shrugged.

The Macchi 326, the Procaer F.400 Cobra and the Morane-Saulnier Paris II stood out in the jet demonstrations, but considerable interest was shown in other new jets on static display. They were:

• **Morane-Saulnier Paris III,** called the MS-760C, shown for the first time in mockup form. Basically a Paris II, the airplane's dominant change is the five-seat cabin with a side door on the port side added to replace the Paris II's sliding canopy. Fifth seat is centered at the aft cabin and baggage area is provided at either side of this seat. Baggage area can be increased by folding

CZECH ZLIN 326, flown by Svinka Vleck, shown as it makes wingover after inverted climb.

BOLKOW JUNIOR was first developed as the Andreasson BA-7 by Convair engineer. Note slab tail. Centered control stick in Bolkow Junior (right) is novel, but company pilots say it is simple to get used to. Shoulder strap is used as a control lock. Stick was centered in order to provide added room in the cockpit of the aircraft.

the fifth seat back. Performance is similar to that of the Paris II. The plane is sold in the U.S. by Beech Aircraft.

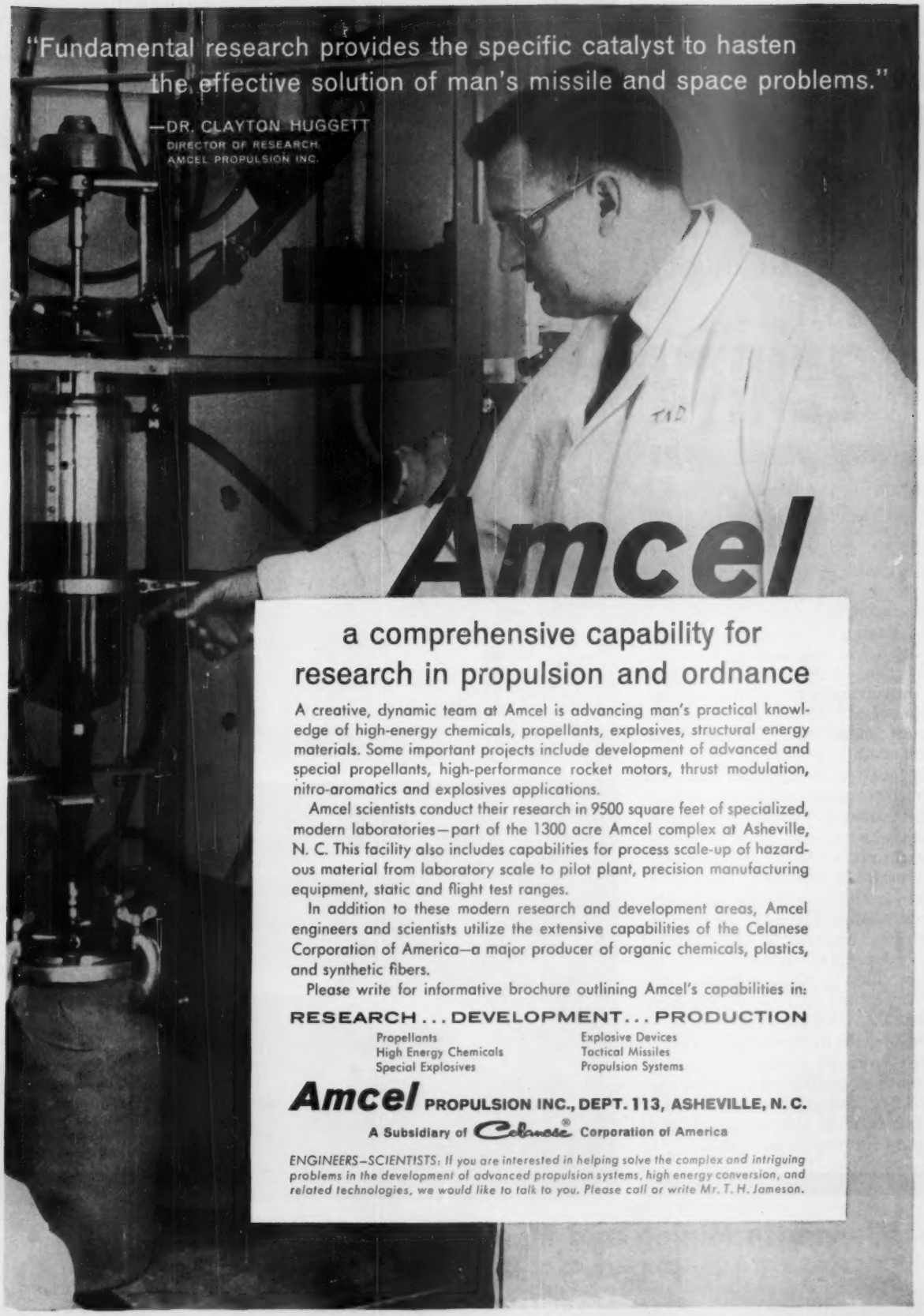
• **SAAB 105 twin-jet** high-wing aircraft, shown at the show in model form, is a contender for the two-place civil market, although at present it is aimed at military liaison and trainer uses. SAAB is building a single prototype at Linkoping, Sweden, with company funds. Designers have aimed stress requirements at U.S. Civil Air Regulations Part 3 for utility and aerobatic configurations. The wing span is 32 ft. 2 in.; wing is of one-piece design. The cabin is pressurized and pilots are seated ahead of the wing. Two Turbomeca ducted fan engines of about 1,600 lb. thrust are planned; Turbomeca did not display the engines at the show. Both engines would be hung on pods below the wing, with the thrust flow passing under the T-tail. In the utility version, the SAAB 105 has a gross weight of 8,160 lb., a limit load factor of 5.33 and a maximum load factor of 8.0. Maximum cruise speed is 450 mph., normal cruise is 390 mph., and range at the latter speed is 1,400 stat. mi. Fuel capacity is 370 gal. carried in integral wing and fuselage tanks.

• **Potez-Heinkel CM.191** prototype, scheduled for first flight in August or September, was mounted in the main salon in a diving turn position (AW May 29, p. 22). Built by Heinkel Flugzeugbau, the CM.191 is a follow-on to the Potez-Fouga Magister two-seat trainer. This version has four seats in civil interior design, and is aimed at executive and feederline operators at a cost of $220,000. Airplane is all-metal with cantilever wings and combined V-shaped rudder-elevator tail unit. Trapezoidal wings in monospar construction have stressed skin and employ Fowler-type flaps. Speed brakes are installed in upper and lower wing surfaces. Fuselage construction is of oval frames connected by four longerons. Range can be increased to 1,650 mi. (about 5 hr. endurance) by installing auxiliary tanks in place of the two rear seats.

The Macchi 326 two-place jet which was barred from the final flying demonstration is one of 10 airplanes completed in a 70-plane order by the Italian Air Force. Powerplant is the Bristol Siddeley Viper 11, but an uprated version, the Mk.20, is now undergoing operational experience in a 326 (AW May 29, p. 74).

Macchi also is building the Lockheed-Macchi Santa Maria, an LASA 60 model, and plans a 13 per month production schedule. First production airplane was shown at Paris and the company has initial orders for 10 in the Mediterranean area. It also will be shown in Great Britain where a leasing company has shown some interest in taking another 10 planes. Powerplant is a Continental IO-470 of 260 hp. Lockheed's office in Geneva, Switzerland, is

MOCKUP of Broussard Major five-place executive plane emphasizes wide landing gear for rough field operation. Plane is designed for skis and floats. Broussard Major mockup interior (right) was fitted with single control for pilot but can be equipped with dual controls. Horizontal and vertical trim controls are on center pedestal. Throttles and mixture controls are hung from ceiling.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Propellants	Explosive Devices
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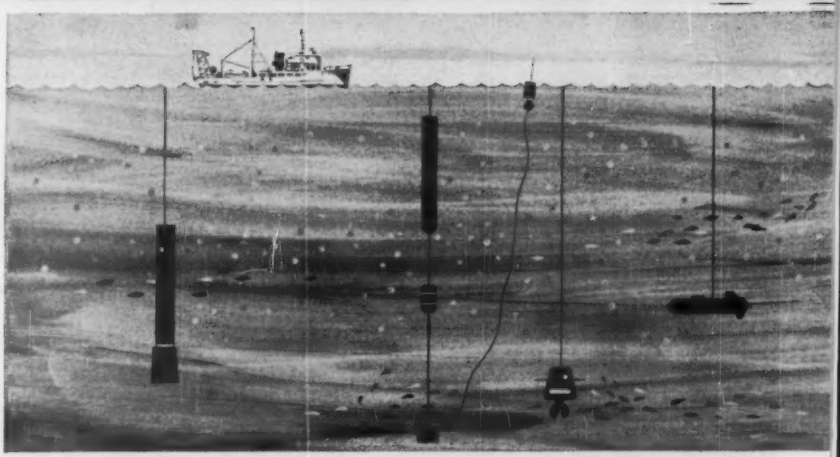
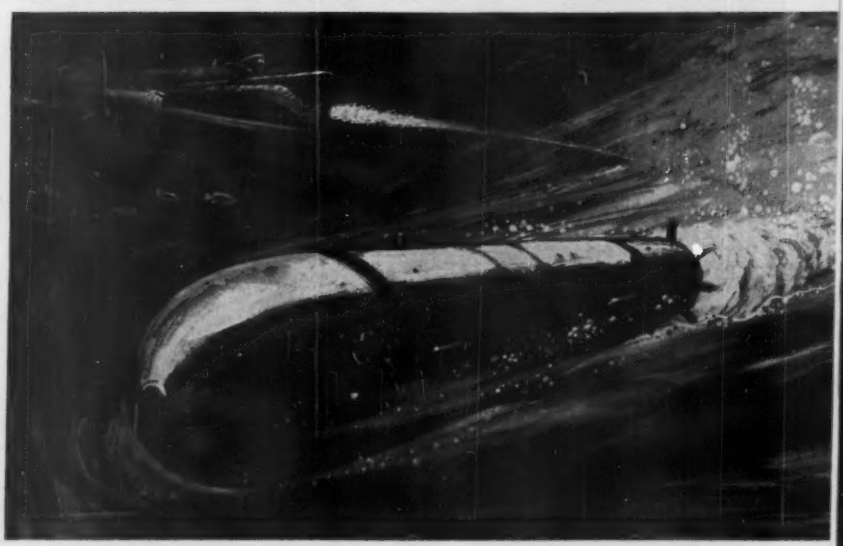
ENGINEERS–SCIENTISTS: If you are interested in helping solve the complex and intriguing problems in the development of advanced propulsion systems, high energy conversion, and related technologies, we would like to talk to you. Please call or write Mr. T. H. Jameson.

THE WONDER MATERIAL FOR ASW IS PLASTICS

...AND THE COMPANY FOR PLASTICS IS ZENITH





Plastics will not corrode. It will not undergo electrolysis. It is non-magnetic. It is more difficult to detect. And reinforced-plastics has an amazing strength, even at great depths.

Zenith has the extensive engineering knowledge, well-equipped reinforced-plastics laboratories, electronic test facilities, and large production capabilities to form resin-bonded glass fiber into virtually any marine component imaginable. Zenith has more than 15 years experience in pioneering new techniques and production processes in plastics.

Zenith has developed its own method of end-over-end filament winding, a process which gives a high strength-to-weight ratio. Zenith has equipment which makes it possible to mold reinforced plastics into huge and highly complex shapes. These are the reasons Zenith has the versatile capability to produce marine components *better* in plastics. This is why Zenith was the company called on to build the first all-plastics LCVP for the Navy.

Consider the many benefits of plastics in your undersea, ASW, and marine projects before you seal the design. Remember, the wonder material for ASW is plastics...and the company for plastics is Zenith.

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helping Macchi in sales promotion. Price in Italy is about $21,000.

Italian designer Stelio Frati's Procaer F.400 Cobra prototype made its first public showing here since receiving its Italian certificate last May 20. The plane is powered by a Turbomeca Marbore II turbine and the design includes a slotted speed brake which drops below the center fuselage at the wing root position. Plane has a speed of better than 360 mph. and price will be in the neighborhood of $80,000. Preproduction batch is scheduled for next September.

In the twin-jet utility field, North American flew its T-39 trainer (see AVIATION WEEK pilot report June 5, p. 54) and will demonstrate it further in Europe to sound out its civil possibilities. The plane showed a high degree of maneuverability; pilots Art DeBolt and Bob Fero rolled the T-39 on the first day's flyby but eliminated the roll the next day, following the Convair B-58 crash (AW June 12, p. 28).

A Czechoslovakian pilot, Svinka Vleck, walked off with the popular honors in his aerobatic demonstration of the Omnipol Zlin 326 two-place trainer. Vleck put the airplane through paces so refined they included low altitude falling leafs and subsequent climbouts from inverted flight, culminating in a slow wingover. The Zlin 326 is a Trener Master basic trainer which has been modified to include an electrically actuated landing gear. Powerplant is a 160-hp. Walter Minor.

Newest of the French lightplanes, the Gardan GY-80, an all-metal, four-placer (AW May 29, p. 23), was delayed in transit to the show by adverse weather and did not participate. The GY-80, named the Horizon, is built by Avions Yves Gardan in cooperation with Hurel-Dubois which is providing facilities and some technical support. The prototype may make a U.S. sales tour in conjunction with interest in U.S. assembly and sales rights.

U.S. rights to two other popular French models, the Morane-Saulnier MS-880 Rallye and MS-885 Super Rallye, are now being negotiated with Coleton Aircraft Corp., Muskegon, Mich. Both Rallyes participated in the flight demonstration, in formation and singly. Marked feature is the automatic leading edge slat for high lift, and the wide span slotted flaps. Morane-Saulnier said No. 4 prototype will tour the U.S. for sales impetus. Production will reach 30 per month this fall.

New Max Holste project is the Broussard Major, a twin-engine five-place executive twin shown in partial mockup, and now being built for first flight next spring. Powerplants are two 310-hp. Continental GIO-470s. Gross weight is 6,950 lb. Dimensions are

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Workmen check bulk containers of pentaborane before shipment to Air Force from Callery's Muskogee, Okla., plant.

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The Callery-developed high temperature data in the next column may provide you with some new directions in your propellant systems design. Other data on pentaborane is available covering density, dielectric constant, heat capacity, solubility, surface tension, vapor pressure and viscosity vs. temperature. Write us for specific details on data and handling procedures for pentaborane.

DENSITY OF LIQUID B_5H_9 vs TEMPERATURE

Temp. (°C)	Observed Density (g/ml)
60	0.5866
70	0.5780
75	0.5741
80	0.5688
90	0.5604
95	0.5561
100	0.5522
110	0.5431
115	0.5389

SOLUBILITY OF NITROGEN IN LIQUID B_5H_9

(Total Pressure 1000 ± 7 psig)

Temp. (°C)	Solubility		
	IGPP(1)	MR(2)	H(3)
30	68.7	0.0559	8.14×10^{-4}
50	68.4	0.0607	8.87
70	67.9	0.0644	9.48
100	65.9	0.0711	10.79
129	62.8	0.0722	11.50
150	59.6	0.0779	13.07

(1) IGPP, Ideal Gas Partial Pressure (atm. Abs)
(2) MR is moles gas/ mole pentaborane
(3) H is MR/IGPP

Callery Chemical Company, Defense Products Department

Headquarters: Callery, Pennsylvania. Telephone Evans City (Pa.) 3510
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...INSPIRATION BREAK

A restaurant is hardly the place for expressing the radiation characteristics of an antenna, but that's how it goes at Grumman. Patrons at restaurants in and around Bethpage, L.I. can easily spot Grumman engineers who, usually in groups of three or four, are engrossed in some theoretical discussion. While no statistics are available it is the Grumman impression that many an inspiraton to the solution of a knotty technical problem has occurred off the Company premises.

Perhaps the best way to describe the Grumman engineer is by what he doesn't like...which is being channeled down a narrow path where he can't branch out and use his own initiative. Technical areas and responsibilities are broad at Grumman and the Grumman engineer expands to meet them. We have found that the informal approach breeds first class engineering ideas.

Engineers seeking this kind of environment for their own abilities are cordially urged to consider the following responsible positions.

Digital Computer Systems Engineer — BSEE with a minimum of 4 years experience in the analysis design and development of digital computers. Will participate in the integration of digital computer into a complex weapons system. A significant part of the effort will be devoted to extensive laboratory and flight development programs.

Secondary Power Engineer — EE or Physicist with understanding of electrical energy generation, thermodynamics and preferably some knowledge of direct conversion of electrical energy from heat and solar energy. To analyze and compare sizes, weights efficiencies of various means of obtaining electrical energy from solar nuclear and chemical energy: to perform preliminary design of secondary power systems for satellites and space vehicles: to participate in hardware development programs.

Automatic Flight Control Systems Engineer — EE or Physics degree with a minimum of 5 years experience in the design and development of autopilot and flight simulators. Work will involve the development of airborne flight control systems and the establishment of military automatic test equipment requirements.

Laboratory Equipment Engineer — BSEE with 5-10 years' experience in laboratory test programs of airborne electronics equipment. A working knowledge is required in a majority of the fields of airborne communication radar navigation and digital computers. Work will be conducted in our new Electronics Systems Center with the finest facilities and equipment available. Applicants must be willing to extend their technical capabilities to new challenging areas ranging from DC to microwaves.

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All qualified applicants considered regardless of race, creed, color or national origin.

wingspan, 50 ft., length 35 ft. and wing area, 301 sq. ft. Maximum cruise will be 159 mph.

A German airplane that aroused considerable interest was the Do.27T, a basic six-place Do.27 fitted with a Turbomeca Astazou turboprop of 522 ehp. mounted in place of its usual Lycoming GO-480 engine. Sister airplane, the twin-engine Do.28 six-to-eight seater with two 250-hp. Lycoming O-540-A1D engines, demonstrated its remarkable slow-flight characteristics, operating in a 21-kt. wind at near-zero speeds. Builder is Dornier-Werke.

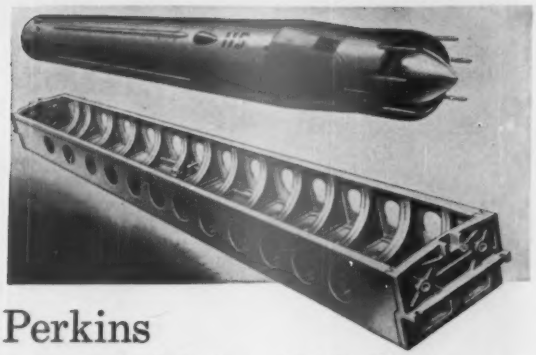
Promising lightplane from Germany, via Sweden and the U. S., was the Bolkow Junior, first built as the Andreasson BA-7 by a Convair engineer at San Diego (AW June 27, 1960, p. 88). The plane was licensed by Andreasson to the Swedish firm of Malmo Flygindustrie but the license was taken over by Bolkow-Entwicklungen KG. Bolkow says it may build 200-plus starting next fall, depending, of course, on sales interest. The plane is a high wing NASA 2300 airfoil two-place (side-by-side) sport and aerobatic model. Wing is swept forward 3 deg. Leading edge is drooped. Stubby appearance is relieved by the swept tail. Bolkow Junior was designed for aerobatics under CAR Part 3 and major components are stressed for 6g. Powerplant is a 100-hp. Continental.

Another company entry was the second prototype of the Bolkow F. 207 which made its first flight Apr. 27 at Stuttgart. The airplane is a follow-on development of the Klemm KL. 107C and has a handsome executive interior with considerable vision from a redesigned canopy which lifts upward from the side for entry. Considerable use of plastic is made in construction. The design profile, however, is marred by a large, faired tailwheel which can be locked for takeoff and landing.

Newest U. S. lightplanes shown were the Piper Colt sportplane and the Cherokee replacement (see p. 125) for the Tri-pacer which made first appearances here. The Cessna Skywagon also participated in its first public appearance in Europe.

British lightplane entry was the Beagle-Auster Airedale (AW May 15, p. 121) and was flown here by Ranald Porteous, chief test pilot. Beagle did not show its Terrier, the civil version of the Army Auster Mk. 6. Company is working on a new twin-engine model which will not be unveiled until the annual Farnborough Show next September at London. Airedale is completing its certification flight tests.

Beech Aircraft entered and flew its complete line, but found more attention attracted by the flight demonstration of the Sferma Marquis, a Beech Baron converted to Turbomeca Astazou powerplants.



Missile tray made by Brooks & Perkins *beats target weight by 300 lbs.*

Air transported missiles require minimum weight handling equipment so that important defense weapons can be moved efficiently and on schedule. Recently, Brooks & Perkins was given the responsibility for engineering, designing, building the prototype and manufacturing an aluminum missile tray, shown above.

Unusual loading problems and the extreme importance of deflection required a dimensional tolerance of ± 1/32" in the 33-foot over-all length at 68°F. B & P not only met all tolerance requirements, but also reduced the initial target weight by 300 lbs.

The aluminum missile tray is another example of Brooks & Perkins skill and experience in the fabrication of light metal products for ground support equipment.

For more information and details of this and other GSE programs, write direct to Brooks & Perkins, Detroit.

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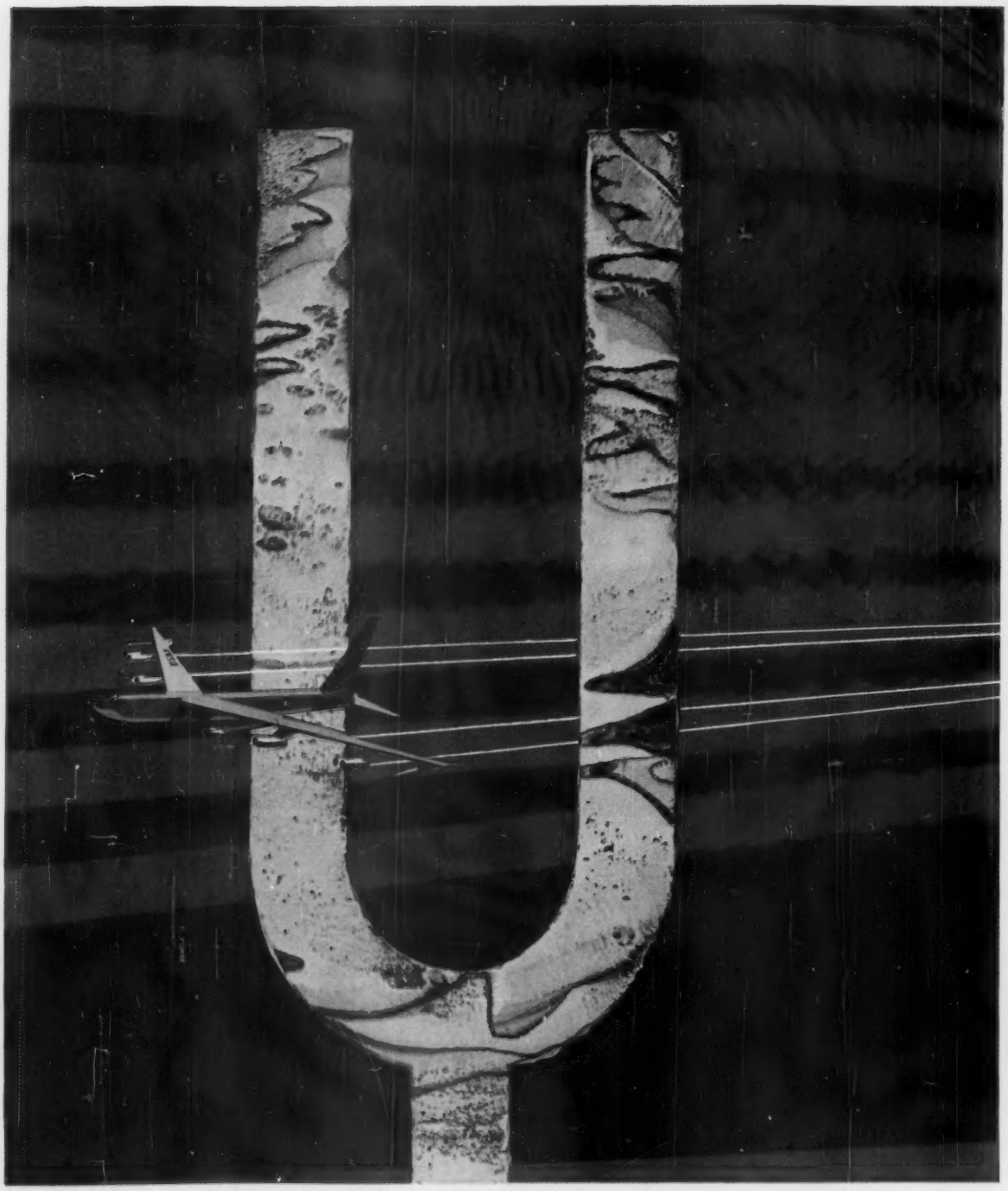
PROBLEMATICAL RECREATIONS 71

Arrange the nine digits in three groups of one, four and four digits so that the third number is the product of the first two. There are at least two solutions. —*Contributed*

There are at least four dozen photographs in our new Pictorial Profile of Litton Industries, a portfolio of our operations throughout the world. Big, readable type. You may have a copy to browse through by simply telling us your address. Tell: Pictorial Profile Department, Litton Industries, Beverly Hills, California.

ANSWER TO LAST WEEK'S PROBLEM: Since each of v/w^2, w^3/x^4, x^5/y^6 and y^7/z^4 is a constant, therefore their product $\frac{v}{z} \cdot \frac{w}{z} \cdot \frac{x}{z} \cdot \frac{y}{z}$ is a constant.

LITTON INDUSTRIES, INC.
Beverly Hills, California



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Back in 1930, your principle helped provide the first step in the development of radar. Since that time, radar has grown up . . . always depending on the Doppler shift to measure the velocity of a moving object. Now, we're about to put your principle to work again; this time as an integral part of the Bombing Navigation System for the B-52 weapons system.

If you would like to help us apply yesterday's principles, like Doppler's, to important projects like B-52 navigation, and if you have a BS, MS or PhD in EE, ME, Physics or Math, please contact Mr. G. F. Raasch, Director of Scientific and Professional Employment, Dept. A, 7929 S. Howell, Milwaukee 1, Wisconsin.

All qualified applicants will be considered without regard to race, creed, color or national origin.

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Cherokee Fills Role as Tri-Pacer Heir

By Andy Keil

New York—Stability, economical cruise performance and docile stall characteristics have been developed and combined into the low-wing Cherokee by Piper Aircraft Corp. to make it a successful replacement for the low-cost Tri-Pacer.

The Model PA-28 Cherokee is now in quantity production at Piper's new Vero Beach, Fla., plant and first deliveries began this month.

With its slightly dihedral wing, swept-back tail and tricycle gear, the Cherokee (AW Jan. 9, p. 100) greatly resembles the larger, higher-powered, retractable-geared Comanche.

CHEROKEE flies over Piper's Vero Beach, Fla., manufacturing facility where the low-wing, four-passenger, all-metal aircraft are being built.

Glass Fiber Structures

While primarily all-metal, the Cherokee's nose cowl, wing tips, stabilator, fin and rudder tips are of glass fiber—Piper's method of simplifying construction problems and reducing costs.

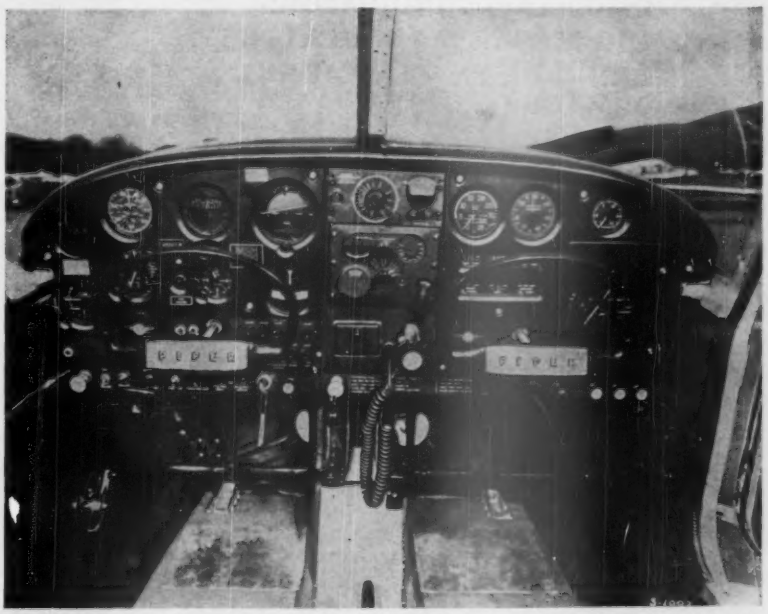
The four-place aircraft, with its 74-in.-dia. Sensenich fixed-pitch metal propeller, can be equipped with either the 150- or 160-hp. Lycoming engines. With the 150-hp. engine the Cherokee grosses 2,150 lb. with an empty weight of 1,185 lb. and a useful load of 965 lb. The 160-hp. engine plane grosses 2,200 lb., has an empty weight of 1,195 lb. and a useful load of 1,005 lb. Both models have a standard fuel capacity of 36 gal. with a maximum capacity of 50 gal.

The wing is an NACA 652-415 airfoil section with a span of 30 ft. and an area of 160 sq. ft. It has a 7-deg. dihedral angle and a loading factor of 13.4 to 13.8 psf. Slotted flaps, controlled by a handle between the front seats, cover 14.6 sq. ft. of wing area and can be lowered to 10, 25 and 40 deg.

The 23.3-ft.-long aircraft stands 7.3-ft. high on its tricycle non-retractable gear. The main wheels have a tread of 10 ft. and are controlled by hydraulic brakes operated by a single control lever accessible to either front seat occupant. The steerable nose wheel, linked to the rudder pedals, has a turning radius of 30 deg. in either direction.

The cabin is entered via a right wing walk-up. Accommodations are adequately roomy with adjustable front seats and removable rear seat which increases the size of the 19-cu.-ft. baggage compartment to 44 cu. ft. Baggage can be loaded through a separate outside door aft of the cabin door and convenient from the ground.

All flight instruments are located in front of the pilot's position; radios occupy the center panel, and engine instruments are located to the right of the full instrument panel.



FLIGHT INSTRUMENTS in Cherokee, including full gyro panel, are located to left side, radios in center and engine instrumentation to right in instrument panel.

Aviation Week's evaluation was made on a cross-country flight in aircraft number N5001W, the fourth Cherokee and second production model to come off the production line. This Super Custom 160-hp. Cherokee was being ferried to the Piper Lock Haven, Pa., facility.

Takeoff was from Flushing Airport, N. Y., with gusts of 10 to 15 kt. and ceiling of approximately 2,200 ft. Air was turbulent en route with ceiling rising westward to a height of 4,000 ft. over Lock Haven. Intermediate stops were made at Morristown, N. J., to pick up another passenger, and at Williamsport, Pa.

With master and fuel pump switches on, the cold Lycoming engine started with a push of the starter button and with relatively few turns of the propeller.

Dodging the numerous ground puddles left by the rain the night before

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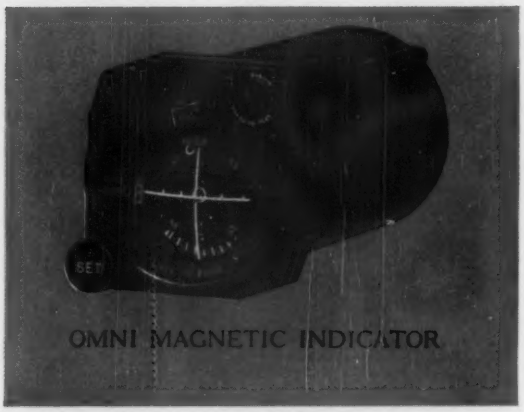

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Van Nuys Facilities Completed

Van Nuys Skyways has completed new facilities as well as the blacktop in the foreground of the photo. Located on the northwest corner of Van Nuys (Calif.) Airport, Skyways has about 25 T-hangars, maintenance and repair hangar of DC-6 size, aviation and jet fuel facilities, coffee shop, parts and distribution outlet, Federal Aviation Agency district offices, roomettes, ample outdoor tiedown parking and full repair and servicing capability.

demonstrated the relatively quick steering and short turn radius of the steerable nose wheel. Tricycle gear attitude and large window area offered good ground visibility.

Taxiing into position after a satisfactory magneto check, full throttle was applied for takeoff at 2,700 rpm. The Cherokee broke ground at 65 mph. in about 500 ft. and speed was allowed to increase to best climb speed of 85 mph. at a rate of approximately 1,000 fpm. This rate of climb placed the aircraft in an uncomfortable nose-high attitude, so the nose was allowed to drop for a shallower climb angle. Leveling off at 1,500 ft. and an indicated airspeed of 123 mph., we skirted Manhattan Island and Teterboro Airport. Flying in the turbulent air, en route to Morristown, the Cherokee had ample opportunity to demonstrate the responsive aileron control and stability inherited from its Piper design. Although "hands-off" flying was impossible, it was relatively easy to hold heading and altitude in the rough air despite the size and weight of the aircraft.

At all three stops the traffic pattern was flown at 110 mph. with "over the fence" speed and flap configuration varying on each landing. With a landing speed of 56 mph., and excellent rudder and aileron control right up through the stall, combined with a steerable nose wheel and tricycle gear, the Cherokee is an easy airplane to land.

Between Williamsport and Lock Haven the ceiling increased to 4,000 ft. and inasmuch as the turbulence had diminished to a point where accurate instrument readings were feasible, the test portion of the Cherokee flight was initiated.

At 2,500 ft. the aircraft was trimmed to fly straight and level, hands off. With 24-in. manifold pressure and 2,450 rpm., we indicated 128 mph. for a true airspeed of 132 mph.

In all stalls the Cherokee was gentle and reluctant to fall away. Minimum loss of altitude and no wing-dropping resulted from each stall. Clean, straight-and-level, power off, the aircraft stalled at 66 mph. with the stall warning light flashing at 70 mph. With full flaps, the Cherokee stopped flying at 56 mph., again with the warning light preceding the stall by approximately 5 mph. In the worst configuration a pilot could get into, that is, steep turn with full flaps, the aircraft stalled at 55 mph. and recovered promptly with slight loss of altitude after the wings were leveled.

The Cherokee will be available in four models with either 160- or 150-hp. Lycoming powerplants. Prices for the 160-hp.-engine models are: Standard, $9,995; Custom, $11,195; Super Custom, $12,195; and Auto Flite, $12,995. The 150-hp. aircraft sell for $200 less in each model.

Peak production of five aircraft a day is expected to be reached this fall. The first 15 Cherokees will probably remain in the Piper organization as demonstrator models.

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Wide Range of Properties Available To meet the broadest possible variety of customer requirements, Hexcel supplies HRP Honeycomb in 6 standard and 13 special core types, with a wide range of mechanical properties and with densities ranging all the way from 1.6 to 15 lbs./cu. ft.

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Facilities. Presently under construction on a 110-acre site at Redondo Beach, near Los Angeles International Airport, is the STL Space Technology Center comprising ten buildings specially designed for research and development in missile and space systems, for the fabrication and environmental test of subsystems and components, and for the production of scientific and technical devices derived from STL's sustained research program. These new facilities will be augmented by the STL research and fabrication installation at Canoga Park, California.

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BALLISTIC MISSILE PROGRAM MANAGEMENT (Los Angeles, Vandenberg AFB, Norton AFB—San Bernardino). Responsible for systems engineering and technical direction for the Air Force ICBM Weapon Systems Programs—Atlas, Titan, and Minuteman—including achievement of all technical objectives of these programs.

MECHANICS DIVISION (Los Angeles). Responsibilities of the Propulsion, Engineering Mechanics, and Aerosciences Laboratories within this division include: analyzing and evaluating performance of rocket engines, propellants and propulsion subsystems and components; conception, design, development, and evaluation of ballistic missile and space vehicle systems; development and implementation of structural, dynamic, aerodynamic, and re-entry vehicle research and development concepts for both ballistic missile and space vehicle programs; and development of new subsystems for missile and spacecraft applications.

SYSTEMS RESEARCH AND ANALYSIS DIVISION (Los Angeles). *Systems Research Laboratory* activities include: management of complete space and missile systems studies including initial design; operations analysis; preliminary design in such areas as structures and aeromechanical and electromechanical systems; trajectory and error analysis; space navigation; and communication systems. *Computation and Data Reduction Center* performs the following functions: numerical analysis; applied mathematics; statistical analysis; scientific programming; computational systems programming; data processing analysis; and test evaluation programming and analysis.

ELECTRONICS DIVISION (Los Angeles). The Communication, Electromechanical, Guidance, and Space Physics Laboratories of this division are responsible for analysis, design, and development of advanced guidance, control, and communications systems for ballistic missiles and space vehicles—from applied research to electronic product and ground support equipment design. Disciplines include the physical, electronic, and electromechanical aspects of guidance, tracking, control, communication, and computer systems, geophysics, and space physics.

RESEARCH LABORATORY (Los Angeles and Canoga Park, California). Fields of interest include: physical studies of gaseous electronics, artificial meteors, reactor kinetics, microwave electronics; studies of quantum chemistry, thin film applications, electron and ion dynamics, and theoretical physics; heavy particle studies; ion propulsion research including neutralization and beam diagnostics, emitters, acceleration and ion optics, and engine design.

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ELECTROMAGNETIC SYSTEMS DIVISION (Canoga Park, California). The Radio Physics and Signal Equipment Laboratories of this division are engaged in developing advanced communication, radio direction finding, electro-optical, and penetration and reconnaissance systems; and in investigating advanced signal processing, electronic and anti-submarine warfare techniques.

FLIGHT TEST OPERATIONS (Cape Canaveral). Responsible for directing systems test programs and for supplying technical leadership to contractors conducting flight testing of ballistic missiles, space programs, and vehicles modified for special development purposes.

Resumes and Inquiries from engineers and scientists, at all levels of experience, will receive prompt and careful attention. All qualified applicants, regardless of race, creed, color or national origin, are invited to communicate with Dr. R. C. Potter, Manager of Professional Placement and Development, for opportunities in Southern California or at Cape Canaveral.

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WHO'S WHERE

(Continued from page 23)

Honors and Elections

Joseph A. Walker, engineer-test pilot for the National Aeronautics and Space Administration, has been named the recipient of the Institute of the Aerospace Sciences' 1961 Octave Chanute Award "for experimental flight testing of and engineering contributions to high-speed flight research programs, including the X-1 through X-15."

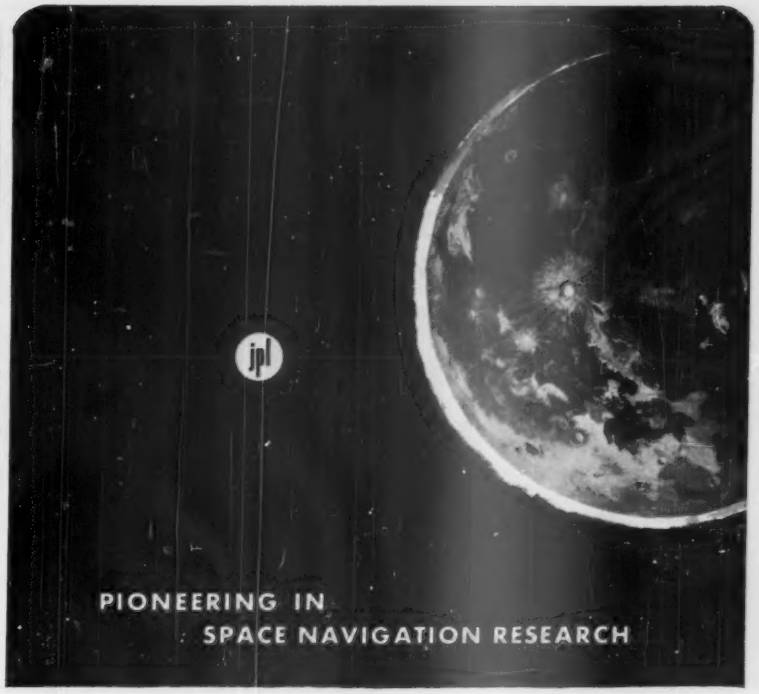
Sir Sydney Camm, director and chief engineer of Hawker Aircraft, Ltd., and **J. D. North,** chairman and managing director of Boulton Paul Aircraft, Ltd., have been elected to Honorary Fellowships in The Royal Aeronautical Society. The Society will also present the following awards at the Wilbur Wright Memorial Lecture, Sept. 12: Honorary Companionship to **J. N. Toothill,** director of Ferranti, Ltd., Hollinwood, Lancashire and general manager of Ferranti, Ltd., Edinburgh; The Silver Medal to **R. Hafner,** technical director (research) of Westland Aircraft, Ltd., "for his outstanding work in the design and development of rotary wing aircraft"; The Bronze Medal to **L. Haworth,** assistant chief engineer-propeller turbines of Rolls-Royce, Ltd., "for his work leading to advances in aircraft gas turbine design"; The British Gold Medal for Aeronautics to **Dr. S. G. Hooker,** technical director (aero) of Bristol Siddeley Engines, Ltd., "for his outstanding practical achievement in aero-engine design and development"; The British Silver Medal for Aeronautics to **Pierre Satre,** technical director of Sud-Aviation, "for his practical achievement in aircraft design, with special reference to his development of the rear-engined configuration"; The Wakefield Gold Medal to **Dr. E. Eastwood,** director of research of Marconi's Wireless Telegraph Co., Ltd., "for his contributions toward safety by the development of air traffic control and navigational aids"; The R. P. Alston Medal to **R. P. Dickinson,** superintendent of Aeroplane and Armament Experimental Establishment, "for his practical achievement in the execution and direction of flight test observation work"; The N. E. Rowe Medals, awarded for the best lecture given to any branch of the society by a member of a branch, to **J. Wilding,** Chester Branch, and **W. Bishop,** Brough Branch; The Alan Marsh Medal to **Jack Brannon,** a Bristow Helicopters, Ltd., pilot, "for his evacuation of an injured oil-man from the off-shore drilling rig . . . Jan. 26, 1960"; The Alan Marsh Award, awarded to a British student who has shown exceptional ability in technical study in the rotary wing field, to **M. S. Eden,** who will return to Saunders-Roe Division of Westland in July, 1961.

Changes

Cdr. Paul Hunter Backus (USN, ret.), corporate coordinator, Sanders Associates, Inc., Nashua, N. H.

Gilbert M. Edelman, assistant for planning to the vice president of sales, Republic Aviation Corp., Farmingdale, N. Y.

Carl R. Wetterau, assistant chief engineer, Greer Hydraulics, Inc., Los Angeles.



The Jet Propulsion Laboratory in Pasadena, California, has been given the responsibility by the National Aeronautics and Space Administration of managing and executing a number of highly significant explorations in space. They include lunar and planetary missions such as fly-bys, orbiters, and unmanned roving vehicles for the observation of the surface of the moon and the planets. Other missions planned for the future involve trips outside of the ecliptic and beyond the confines of the solar system.

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Other examples of present research activities in this area are cryogenic studies related to gyro and computer techniques, gas lubrication and flotation of sensing masses, research in solid-state physics, and many others.

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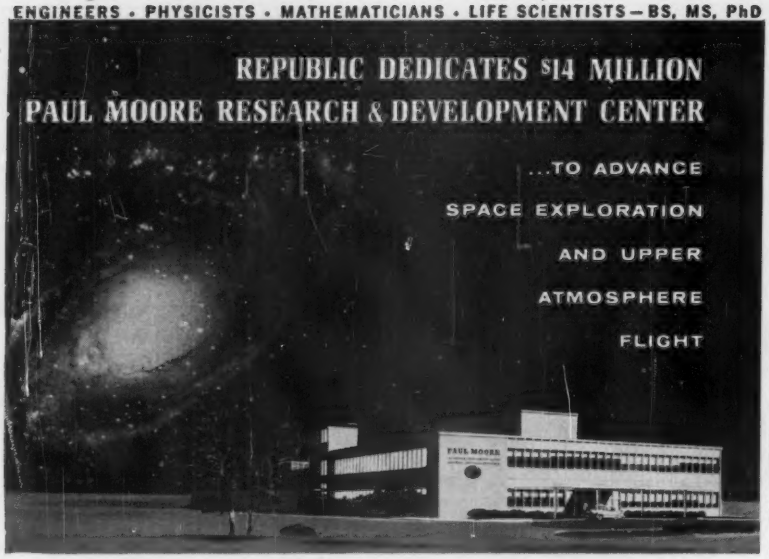

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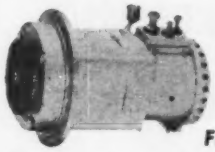

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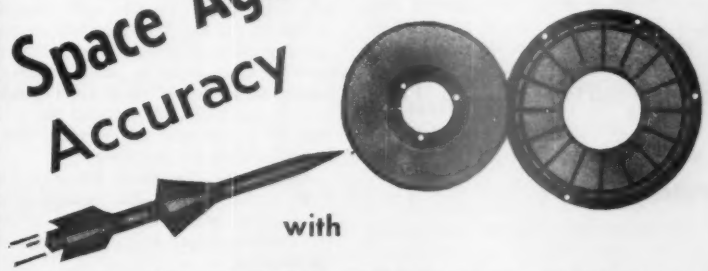
Space Age Accuracy



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LETTERS

European Market

Congratulations to Cecil Brownlow for his thorough survey of U. S. investment and license agreements in the European aerospace industry (AW Apr. 24, p. 54; May 1, p. 154; May 8, p. 119). I thought he described very clearly the dilemma between the desire to expand into a profitable market and the fear of creating tough competition in the future.

One point might have been added: the enormously strengthened position of the United States in propulsion. Eight or 10 years ago our aircraft industry was largely dependent on British-designed turbojets, and substantial sums were paid out for license rights and engineering assistance. Fortunately at least some engine companies recognized that such dependence is, at best, only a short-term solution to a gap in advanced design planning, and today the picture is completely reversed.

Piston engines, gas turbines and rockets of U. S. design are now being built in England, France, Germany, Italy and Belgium, besides a number of ground gas turbines. It also seems likely now that the automotive gas turbine will be on sale first in this country.

In two important areas, however, European gas turbine design is still (unnecessarily) in the lead. In spite of the active interest shown in VTOL by the U. S. Army and Navy, Rolls-Royce is several years ahead of anyone else in the development and control of extremely light lifting turbojets. Secondly, although our volume of domestic business flying is many times greater than that of the rest of the world put together, we have nothing to compare with Turbomeca's neat, low cost, push button controlled business turboprops.

J. M. Stephenson
Fairfield, Conn.

Zeus Future

I was taken back somewhat upon reading Mr. R. W. Boesel's recent comments (AW May 1, p. 168) on the Nike Zeus anti-missile system.

It hardly seems reasonable to can the only truly defensive system against missiles when it is close to reaching production. If the system simply doesn't work, all right; but it is a question for the experts.

Retaliation is only good defense if it is absolutely crushing and devastating in magnitude and effect. This is not our present position, and because of the non-aggression policy of the United States we need defensive systems even more.

Since America is the prime target of communism, in the end we must either fight or give up, and, in view of the long standing Soviet policy of mass murder, surrender is out of the question. We might fight . . . and win.

If Nike Zeus works at all, let's keep it, and if there is something wrong with it let's fix it, but don't throw it out.

(Name Withheld by Request)

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

F4H Armament

Reference the article published in AW May 29, p. 31, "Air Temperature Cuts F4H's Record Speed," you state that these aircraft carried two Sidewinder missiles.

In fact, these record breakers plus all operational F4Hs carry Sparrow III missiles as their primary weapon.

Frank C. Bonansinga
Raytheon Flight Test
Bedford, Mass.

(Reader Bonansinga is correct; the McDonnell F4Hs carried Raytheon Sparrow III air-to-air missiles.—Ed.)

Clubbing the Clubs

Business Week (June 3) and Aviation Week (June 5, p. 42) report the CAB charge that club privileges, "amount to unlawful discrimination" against non-member passengers who pay the same prices for their tickets and "unfair competition" to non-club airlines.

Taking up the unofficial but jealous cry of the "have not" airlines against the "haves," may be a CAB function. If the regulations truly treat the clubs as unlawful, CAB might equally well consider a change in the regulations instead of merely ordering clubs abolished, being made "wide open" (impractical in many states), or limited to operation under CAB standards.

Is it immoral and unlawful for a company or a merchant to recognize the frequent high volume customer?

Are not the alternatives advanced by the CAB in themselves a discrimination against a minority group of seasoned travelers? Is discrimination being confused with qualification?

And, is it fair or truly in the public interest for the government to take a competitive weapon away from a few airlines after they legally developed it on their own initiative? The weeping cry of "unfair" raised after 25 years of club existence is a sad basis for a new CAB "enforcement proceedings," and is just another government penalty imposed on success.

Arnold E. Hayes
George Galvin
Drexel Hill, Pa.

Progress in Space

Dr. Chapman's letter (AW May 8, p. 134) is a fine example of a well written, excellently documented piece of prose—without any originality.

Much of what he says is true, more is conjecture. I would appreciate it if you would print letters which offer constructive criticism. Tens of millions of persons in the United States can point to the failures in our space programs, as Dr. Chapman has done.

Only a comparatively few can indicate the way to accelerated progress.

NASA and the Armed Services are making tremendous progress, considering the fact that no one in the federal government administration could even spell SPACE before 1958.

Three years later, in 1961, the Administration—executive and legislative—doesn't seem to comprehend the potential gains to be made through space exploration. They obviously don't understand the magnitude of the job. Money for space is still hard to come by.

I am not qualified to solve the awesome problems of government. But I have one suggestion: let the federal government stop all of the "pork barrel" projects. Obviously there is not enough tax money to go around. Lenin may have been keenly aware of this when he said, "We shall force the United States to spend itself to destruction." Rather than be destroyed by drowning in our own fat, let the liberals in government at all levels reverse the pell-mell race into socialism.

I pray to God that the United States of America will have less government and more individual responsibility.

James A. Martin
Lancaster, Calif.

Electric Throttle

We were most interested, and somewhat surprised, to see in the Feb. 27 edition of Aviation Week, p. 98, reference to an electric throttle control system where the statement was made that the B-70 will be the first aircraft to fly with an electric throttle control with no backing up mechanical system.

Ultra Electronics developed the first complete electric throttle control system for the Bristol Britannia aircraft, and this has now been flying satisfactorily with no mechanical back-up systems for three years. In April, 1960, we celebrated one million engine flying hours of this equipment, and by the autumn of this year it will have logged two million flying hours.

To date, this equipment has given, according to the Britannia operators, excellent service, and to date, there has been no instance of the loss of control of an engine. We are currently developing two more such systems for new aircraft and it is our feeling that with the advent of automatic landing and supersonic flight, electric throttle controls systems will become more widely used.

R. J. Russell-Bates
Senior Project Officer
Ultra Electronics, Ltd.
London, England

(Instead of saying the B-70 would be the first aircraft to rely on electric throttle control system, the caption should have said it would be the first USAF aircraft to be so equipped.—Ed.)

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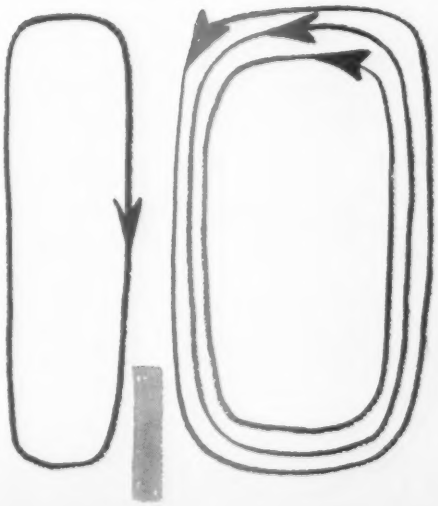

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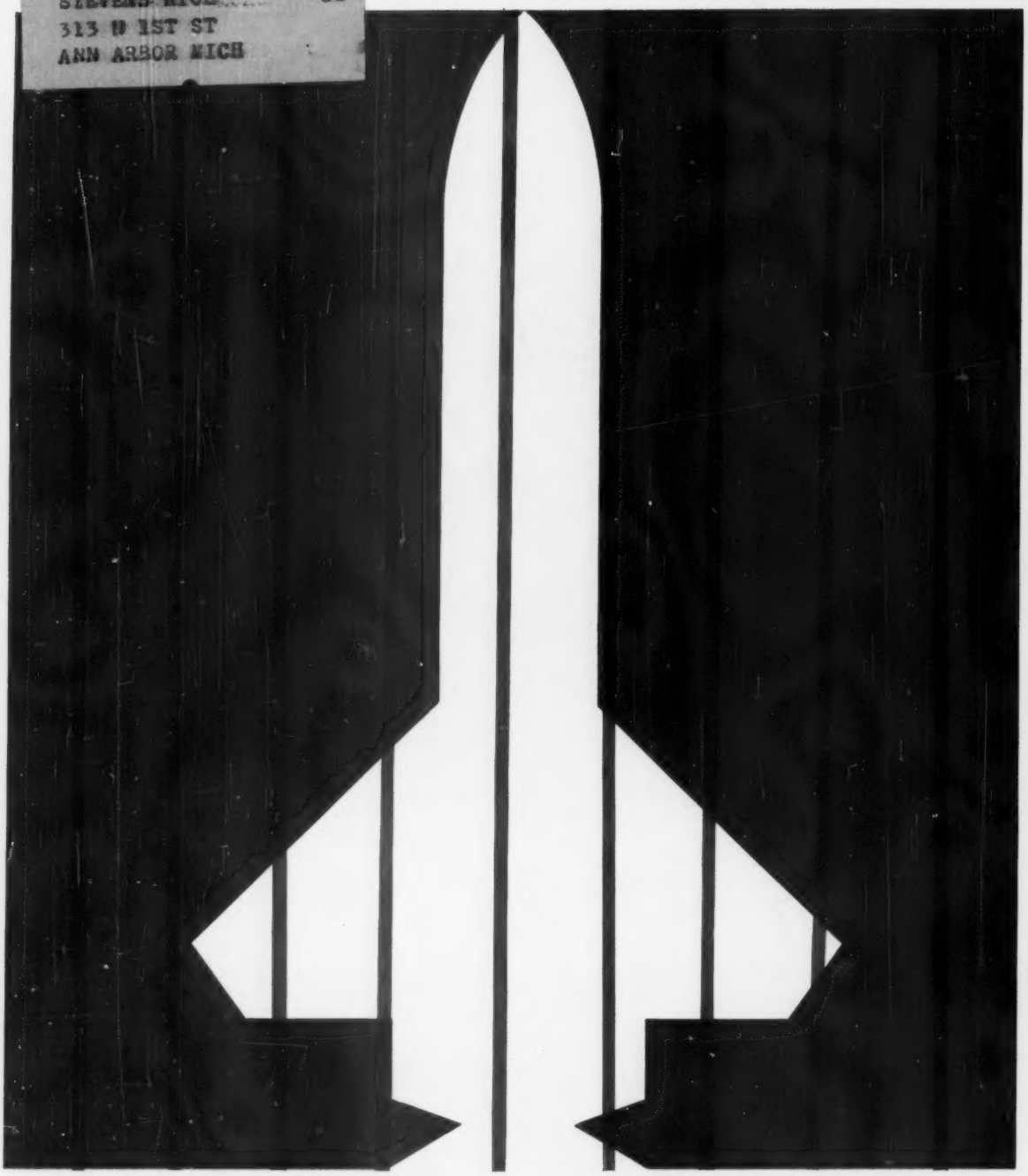

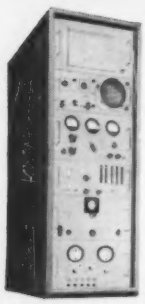

CM-122/DSM Signal Comparator

WHO GUARDS THE GUARDIAN?

Look at some of the guardians of our Western civilization: Terrier, Talos, Polaris. Then ask yourself, as the Romans did, "Who guards the guardian?" Who makes certain that this regiment of space-age sentries stays ready for instant action?

Who? Varian Associates, for one. Varian has developed a CM-122/DSM Signal Comparator for the Navy's Bureau of Weapons. Its job: to test missile guidance and checkout systems to insure combat readiness of electronic components.

For commercial use, Varian supplies precision test systems such as the V-7200 Noise Measurement Test Set, to measure amplitude or frequency modulation noise from microwave sources.

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